Midwest Engineer

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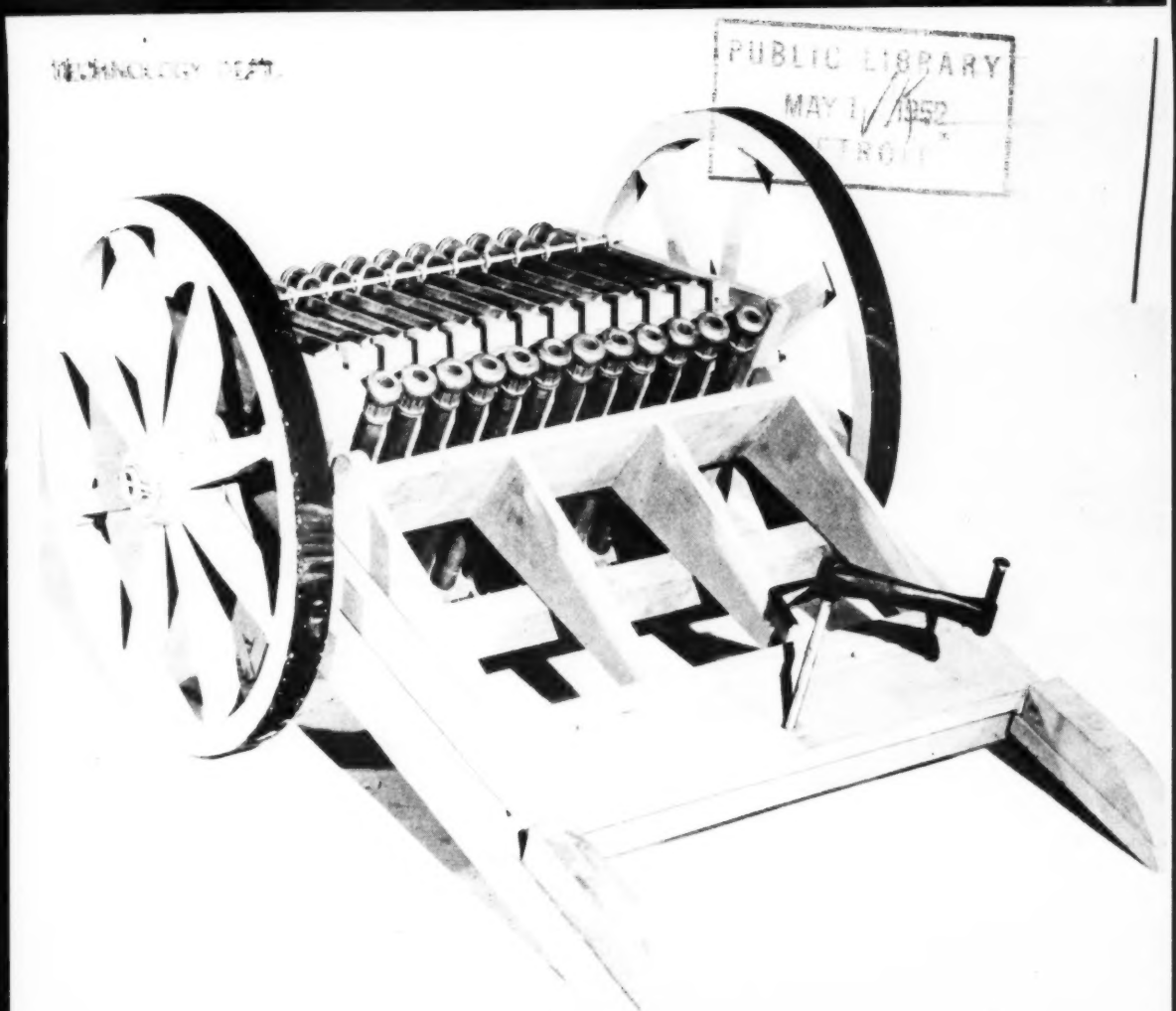

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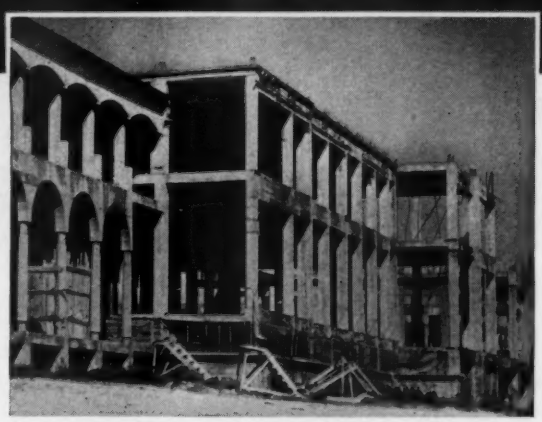
The destructive hurricane of 1926 halted construction of the University of Miami's 8-million-dollar building program—including the Mediterranean style structure designed by Phineas Paist shown in the small photo at the right. For 24 years this reinforced concrete frame and floor skeleton stood exposed to rain, sun and hurricane winds.

In the spring of 1950 a subscription drive was launched to obtain funds to finish the building. Examination showed that the concrete frame was sound so the structure was redesigned by Architect Robert M. Little of Miami Beach, Fla., in keeping with the modern motif of present campus buildings.

The photo above shows the completed structure now known as the Merrick Building. The seven-story 100-ft. tower contains faculty offices and display rooms, the wings classrooms and lecture halls.



Structural engineer for Merrick Building: A. H. Baxter, Coral Gables, Fla.; contractor: Gust K. Newberg Construction Co., Miami, Fla.

●

This is another graphic example of how reinforced concrete construction can "take it." Such construction has the strength and rigidity to resist all static and dynamic loads. It is durable, sturdy and firesafe.

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TECHNOLOGY DEPT.

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FEBRUARY, 1952 Vol. 4, No. 6

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COVER LEGEND

This is the second of a series, to be published by the MIDWEST ENGINEER, of models made from the original drawings of Leonardo da Vinci. This month's cover shows a triple-tier machine gun with 12 guns in each of its three tiers. One tier was to be fired while a second was being loaded and the third was cooling.

April 23, Wednesday Noon Luncheon Meeting

"THE MAKING OF A YANKEE."

April 28, A Modern Parking Plan for Chicago's Loop

SPONSORED BY THE TRAFFIC ENGINEERING AND CITY PLANNING SECTION

Victor Hofer of the Ralph H. Burke Co. will discuss the proposed Grant Park underground parking lot.

April 30, Wednesday Noon Luncheon Meeting

Dr. F. K. Broome, administrative head, auxiliaries research, Armour & Co., will speak on the products of research being developed from the by-products of the meat packing industry. These products are primarily chemicals, adhesives, animal hair products and soap. Title of his talk is, "All But the Squeal."

May 5, Industrial Wastes in the Corn Products Industry

SPONSORED JOINTLY BY THE MECHANICAL ENGINEERING SECTION AND THE HYDRAULIC, SANITARY AND MUNICIPAL ENGINEERING SECTION.

Since 1944, an extensive waste study and elimination program has been carried on by the American Maize Products Co. The speaker for this evening's program is **Dr. G. H. McIntosh,** chemist in charge of the company's control laboratory who will discuss the results of this study. His talk will be illustrated.

May 7, Wednesday Noon Luncheon Meeting

William D. Richards, lighting consultant with the Chicago Lighting Institute will speak on, "Black Light and Its Applications." His lecture will include demonstrations of black light.

May 10, Excursion to Allis-Chalmers Co., at Milwaukee

WSE members and their families are invited to go on an inspection tour through the Allis-Chalmers plant at Milwaukee, one of the world's largest manufacturers of machinery. Members are to meet at the Allis-Chalmers Clubhouse at 9:30 A.M., Saturday, May 10. The clubhouse is at 1115 S. 70th Street, directly across from the main office.

Call WSE headquarters for reservations.

May 14, Wednesday Noon Luncheon Meeting

Arnulf M. Pins, consultant to the Economic and Social Council of the United Nations will describe the story of youth activities on the international level through the United Nations, UNESCO Youth Institute and the World Assembly of Youth. Title of Mr. Pins' talk is, "Youth Takes Positive Steps in the Cold War."

A. L. JACKSON COMPANY

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WSE MEETING REPORT

Forest Preserves

At the regular weekly luncheon meeting held February 20, Mr. James H. Tyndall, Associate Forester, of the Cook County Forest Preserve District gave a talk on the History, Development and Management Policies of the Forest Preserves, as regards forestry and wildlife.

Mr. Tyndall compared the management policies of the early years of the Forest Preserve District with the present policies which have been in force since reorganization in 1929.

In his talk, Mr. Tyndall enumerated the various recreational facilities available in the Preserves, and discussed the problems involved in the management of such an area.

Of particular interest to the group was his discussion of the "abuses" which invariably go hand in hand with very heavy use. He said the Forest Preserve authorities appreciated this problem of protective maintenance, and are combating or attempting to correct these abuses through a well organized educational program.

The speaker also mentioned some of the various species of wildlife found abundantly in the Forest Preserves and elaborated on the wildlife management policies currently in effect.

Physicians' Incomes

Dr. Frank G. Dickinson of the American Medical Association, at the regular weekly luncheon meeting on February 27, discussed a survey of physicians' income made in 1949.

One of the pertinent facts revealed by the survey, according to Dr. Dickinson, was that in the 20-year period from 1929 to 1949, the increase in physicians' average net income conformed almost exactly with the percentage increase of average income for all wage earners in the general population. This fact indicates that physicians as a group have been affected to the same extent as their patients by the inflationary trends.

Dr. Dickinson stated that the survey also reveals the average income of physicians in the far western states was higher than the average income of physicians in other regions of the United States.

The highest median net incomes of physicians were reported for cities of 250,000 to 500,000 population. This fact, stated Dr. Dickinson, makes it appear reasonable that the extremely large cities are oversupplied with physicians.

Dr. Dickinson discussed the effect of inflation on the medical care dollar. The doctors' share of the medical care dollar has dropped from $.32 in 1930 to $.28 in 1950 whereas the hospitals' share of the medical dollar has increased from $.14 in 1930 to $.23 in 1950, which indicates, according to Doctor Dickinson, that inflationary trends have more directly affected hospitals than any other single group involved in medical care.

Shortage of Engineers

Prof. Richard H. Cole, assistant professor of mechanical engineering and student counselor of Northwestern Technological Institute, spoke at the March 10th regular Monday evening meeting, arranged by the W.S.E. Professional Women's Council.

In discussing the problem of the shortage of engineers, Prof. Cole said it is estimated that there is a need for 30,000 engineers yearly, and in time of emergency a conservative estimate of around 40,000. In 1950, 51,000 graduates were readily absorbed by industry; by 1960, due to a steady decline anticipated in the number of graduating engineers, there will be only 18,000 graduated, unless something is done!

Prof. Cole gave these reasons for, and suggestions to help alleviate the expected dearth in graduate engineers:

1. Birth curve—the birth rate fell during the depression and 1951 saw an all time low in high school graduates.

2. Counteract unfortunate publicity given out several years ago by the Bureau of Labor to the effect that there were too many engineers. Some school counselors still believe this.

3. Publicize the fact that, contrary to general opinion, the engineer has every chance in the world of finishing his course uninterrupted by the draft.

4. SUBSIDIZE STUDENT ENGINEERS. The co-op schools, not nearly enough, are doing a great job for students beyond the second year. Also, there are not enough scholarships, and these do not help good material below the "A" average bracket.

Industry can help solve the problem by being sure their engineers are doing engineering work and are not bogged down by work that can be competently handled by technically trained personnel (chemists, physicists, economists, etc.) recruited from liberal arts colleges. Many companies must change their policy of putting young graduates and co-op students in "cold storage" and literally adopt a policy of "wooing" them by a planned integration program to interest them in company policies of advancement and what they can contribute to the company.

Parents can do their part by helping their children to create within themselves a desire for studying without the need of outside drive by parents and high school teachers. The "A" student, who doesn't have to work hard in high school competition, must also be instilled with this inner drive against the time when he comes up against the "tough ones" in college. Parents can also do their part in insisting their children actually receive an honest basic foundation in the three "R's" especially math.

WESTERN SOCIETY OF ENGINEERS

Ladies Night

(Informal Party)

Saturday May 3

DINNER

DANCING

OTHER EVENTS

COCKTAIL HOUR 6 to 7 P.M. DINNER AT 7 P.M.

$4.00 PER PERSON

Reservations Limited

Tables Available For Two Or More

Part One

Great Lakes Levels

and

Their Changes

By Horace P. Ramey

Assistant Chief Engineer
Sanitary District of Chicago

The water levels of the Great Lakes are presently in one of their periodic high stages. Much damage is being done to unprotected shore property and the owners are trying for relief.

Few people realize that the levels of the Great Lakes fluctuate through a range as wide as 5.1 feet on an annual average basis, as much as 6.3 feet on a monthly average basis, some 2 to 3 feet more on daily averages and even more on hourly averages.

A few examples of wide fluctuations in lake levels, in relatively short periods of time may be cited.

The level of Lake Superior rose 2.68 ft. in 6 months, March to September 1869; and fell 1.75 ft. in 7 months, August 1897 to March 1898.

The level of Lake Michigan fell 2.58 ft. in 8 months, July 1871 to March 1872; and 3.29 ft. in 20 months, July 1929 to February 1930. The level of this lake rose 2.10 ft. in 6 months, January to July 1876; and 2.20 ft. in 6 months, January to July 1916; and 3.74 ft. in 17 months February 1928 to July 1929. The latest rise was 3.34 ft. in 20 months, from December 1949 to August 1951.

The level of Lake Erie fell 3.00 ft. in 8 months, June 1919 to February 1920; and 3.15 ft. in 10 months, May 1930 to March 1931. The level of this lake rose 2.52 ft. in 7 months, October 1928 to May 1929; and 3.68 ft. in 16 months, February 1942 to June 1943.

The level of Lake Ontario fell 4.08 ft. in 7 months, from June 1867 to January 1868; and 4.12 ft. in 19 months, from June 1948 to January 1950. The level of this lake rose 3.49 ft. in 7 months, December 1875 to July 1876; and 4.70 ft. in 16 months, February 1942 to June 1943.

There are certain basic data, which may be briefly summarized as follows:

Lake Superior, with a water surface area of 31,800 square miles, lies 21.2 feet higher than Lakes Michigan and Huron.

Lakes Michigan-Huron, which become one lake from a hydraulic standpoint because of the broad and deep connection through the Straits of Machinac, with water surface area of 45,400 square miles, lie only 8.6 feet higher than Lake Erie. The navigation channels between Lakes Huron and Erie are more than 20 feet deep, hence these lakes are closely interconnected.

Lakes St. Clair and Erie, with water surface area of 10,400 square miles, lie 326 feet above Lake Ontario.

Lake Ontario has a water surface area of about 7,500 square miles.

The five Great Lakes have a water surface area of approximately 95,100 square miles, which comprises 32 per cent of the total drainage area of 298,000 square miles.

Changes in Lake Levels

Natural changes in lake levels are due to: 1. Variations in rainfall, in long term cycles; 2. variation in rainfall, run-off and evaporation, in annual cycles; 3. ice; 4. winds; 5. tides; 6. seiches, because of sudden changes in barometric pressure, and 7. earth tilt.

Artificial changes in lake level are due to: 8. Changes in outlet conditions; 9. diversions from the lakes, and 10. diversions into the lakes.

Long term cycles

The greatest single cause of change in lake levels is long continued excess, above the average, in annual rainfall and run-off, less evaporation for a rise in levels; and long continued deficiency in the same for a drop in levels. These occur in cycles of seven years or longer.

Many scientists have maintained that the levels of the Great Lakes rise and fall according to a regular cycle, with periods of almost 23 years between the maximum highs; and with the minimum lows occurring about midway between the maximum highs. This has been ascribed to solar radiation, which varies

on a cycle of approximately 22.75 years and is presumed to affect precipitation. This is a reasonable explanation of the long term rise and fall of lake levels. Other swings in lake levels occur over periods of 5 years, 7 years, 11 years of rise, or fall. The 23 year cycle includes both rise and fall; and some scientists have endeavored, without too much success, to assign to these shorter swings some definite proportion of the longer cycle. The record of levels on the Great Lakes, about 100 years, is not long enough to support such conclusions with exactness.

It is a fact that extreme high levels have prevailed in the Great Lakes in 1862, 1886, 1907, 1929 and 1951, these years of highest annual average levels being 21 to 24 years apart. In this connection your attention is called to a paper submitted to the Western Society of Engineers February 8, 1943 (published in the Society *Journal*, December 1943) by H. A. Musham, a Naval Architect, of Chicago, and long time student of lake levels. This paper was entitled "The Practical Application of the Rhythmic Fluctuation of the Levels of the Great Lakes." One item in this paper is of particular interest. A forecast, made in 1940 for the Great Lakes country, predicted wet weather 1942-1947, dry weather in 1947 and 1948, after which increasingly wet weather was to prevail until 1950-1954, the end of a 23 year period in which lake levels were to culminate in one of their periodic highs. This 1950-1954 period is not yet over, but in 1951 the precipitation in Chicago was about 43.0 inches, or 31 per cent above the normal of 32.8 inches and lake levels were the highest since 1929.

Records of rainfall around the Great Lakes show that the total rainfall over widespread areas is considerably heavier in some years than in others; and that variations from 10 per cent above to 10 per cent below the long term average are common.

An example of extreme variation in rainfall over a wide area is from the precipitation records at Chicago, Detroit and Duluth, for the climatic year July 1, 1881 to June 30, 1882, compared to the like year 1894-95.

	1881-82	1894-5
Chicago, Ill.	49.9 ins.	22.9 ins.
Detroit, Mich.	48.1 ins.	19.9 ins.
Duluth, Minn.	50.3 ins.	21.6 ins.

Thus in the wet year the precipitation was about 2.4 times that in the dry year.

Cycles of rainfall observations, extending back 150 years, indicate there has been no important permanent change in precipitation, although observations of the 65 years, 1860 to 1929, do indicate a slight but well defined decrease of rainfall during that period.

The rapid cutting off of the pine forests, particularly in northern Michigan, between 1870 and 1890, has been estimated by some to have caused a water loss to the Great Lakes; but a careful study of the records 1860 to 1929 does not indicate that this has had any measurable effect on the water supply. It has however hastened the run-off and changed the distribution of evaporation and transpiration.

The water surface of Lake Superior comprises 39.5 per cent of the entire watershed of that lake; the water surfaces of Lakes Michigan-Huron comprise 32 per cent of their watersheds; the surfaces of Erie and St. Clair 25 per cent, and Ontario 22 per cent. On all the Great Lakes the water surface areas amount to 32 per cent of the total drainage areas.

Because of the relatively large proportion of water surface in the entire catchment area, evaporation has an unusually large effect on the elevations and discharges of the Great Lakes.

Apparently in the dry years the evaporation loss is greater than average. Thus the percentage of water from rainfall reaching the lake outlets is much less than the deficiency in supply, as indicated by the lessened rainfall alone. The opposite is true in the wet years, when more water is supplied from the excess rainfall and a greater percentage of this reaches and remains in the lakes, because of the lessened evaporation in such years.

As an example of the effect on lake levels of continued dry years, the level of Lake Michigan dropped 3.26 feet, annual average basis, from 581.40 in 1918 to 578.14 in 1926. On monthly averages the drop was 4.6 feet, from July 1918 to January 1926. Precipitation for the nine years 1917 to 1925 inclusive averaged about 92 per cent of normal. The rainfall deficiency was only 8 per cent, but it was continuous except for one year, 1921, when it was only 3 per cent above normal.

The effect of a few continued wet years has been observed recently. The surface level of Lake Michigan at Chicago has risen 2.35 feet, from the yearly average of 579.18 in 1948 to 581.53 in 1951. On monthly averages this rise has been 3.34 feet, from 578.22 in December 1949 to 581.56 in August 1951. The rainfall was normal in 1948, but it has averaged 21.3 per cent more than normal for three years 1949, 1950 and 1951. In 1951 precipitation was about 31 per cent above normal.

Annual Cycles

Each of the Great Lakes ordinarily stands about one foot or more higher in summer than in winter. This rise is due principally to the heavier spring rainfall. melting of snow and ice, the release of ice-bound tributary streams, and another very important item, namely: the small evaporation loss during the late spring and early summer. After reaching a peak, about mid-summer, the level of each lake usually drops back gradually during the fall and early winter to a low winter level. This is due to greater evaporation, particularly in August, September, and October, and to the lessened stream inflow in the latter part of the year, when the rainfall is usually less. When winter begins and small tributaries become ice-bound, the inflow is further diminished and the lakes reach their lowest levels some time during the winter.

The latitude of the lake and the temperature of its region has some effect on the time of the spring rise, in this yearly cycle. Lake Superior, the northernmost lake, usually stands at minimum stage in March and at maximum stage in September. Lakes Michigan and Huron usually reach their minimum levels in January or February and their maximum heights in August. Lake Erie is usually at minimum stage in January or February and maximum in July. Lake Ontario is at minimum stage usually in February and maximum in June.

Ice

The effect of ice on the levels of the Great Lakes is quite important, and, to a considerable extent, unpredictable.

The deep freezing of tributary streams, varying in amount from year to year, temporarily holds back inflow into the lakes and produces a seasonal effect.

In extremely cold winters the clog-

(*Continued on Page* 24)

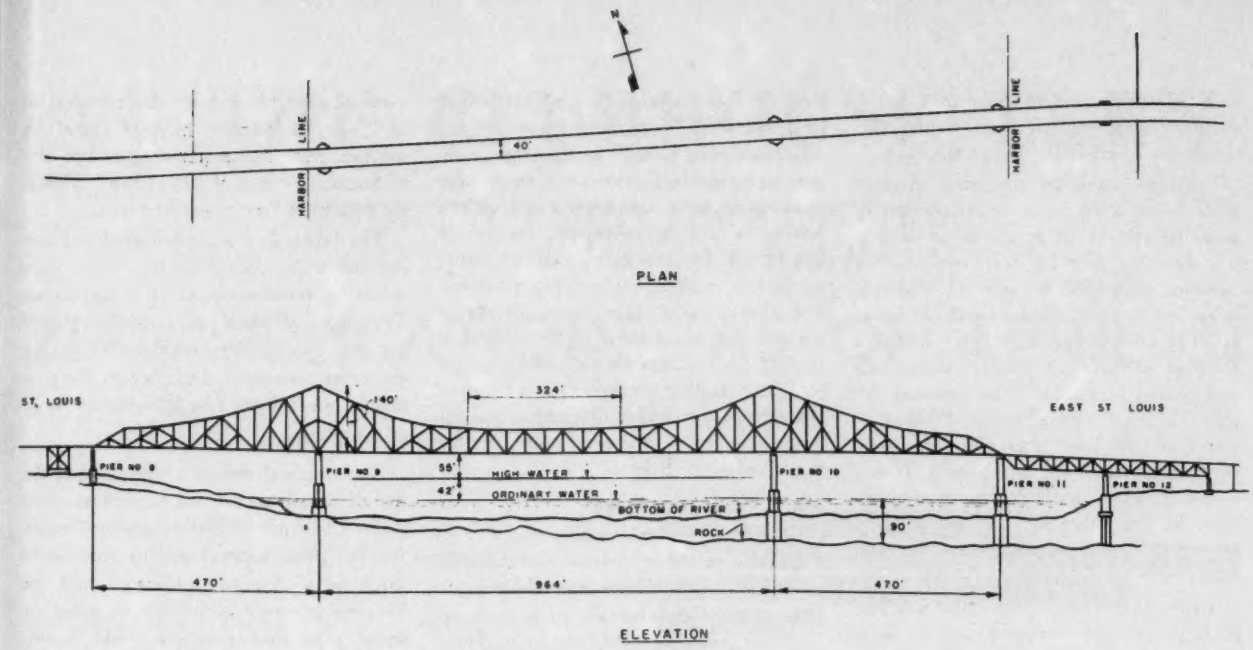


FIGURE 1

THE DESIGN and CONSTRUCTION of the EAST ST. LOUIS VETERANS MEMORIAL BRIDGE

By A. L. R. SANDERS
Chief Engineer
Hazelet and Erdal

A new toll bridge connecting the cities of East St. Louis, Illinois, and St. Louis, Missouri, was opened to traffic in January, 1951. This structure, known as the East St. Louis Veterans Memorial Bridge crosses the Mississippi River at a point about 800 feet north of the world famous Eads Bridge.

The project was financed wholly by toll revenue bonds. Numerous delays occurred in the financing prior to the purchase of the bonds by the banking interests, and but little time was left in which plans and specifications could be prepared, bids taken, a contract awarded and work started before August 7, 1947. It was imperative that work be started before that date, since federal laws prohibited the issuance of 30 year bonds for any interstate toll project started after that date. The banking interests would not attempt to finance the project on the basis of 20 year bonds, which were permissible under the recent Congressional Act prohibiting the issuance of 30 year bonds. In spite of the short time allowed for the preparation of bidding plans, the project was completed with an overrun in cost of about 3% on the basic contract. The chief causes of this overrun were: (1) a War Department demand that the structure be raised to a height sufficient to permit the construction of a railroad on top of the levee along the eastern shore, (2) the Missouri Commerce Commission's requirement that the structure be raised on account of a future and highly improbable relocation of the elevated tracks along the western shore and (3) to the relocating of public utilities on an extra work basis.

The project was about 1½ miles long and actually consisted of a river crossing between the two cities and a grade separation structure in East St. Louis. The river crossing and the grade separation structure were connected by a hydraulically placed embankment, approximately 1,700 feet long. The embankment was widened out, approximately half way between the two structures to form a toll collecting plaza.

Substructure

The main river piers are all founded on hard limestone. Pier No. 9 was con-

structed inside a steel sheet pile cofferdam in fairly shallow water with practically no overburden above the rock.

Caissons, sunk by dredging through wells, were used in the construction of piers 10 and 11. A single large caisson was used for pier 10, and twin circular caissons were used for pier 11, which is subjected to much lighter loads than pier 10. The caissons were sunk to within a few feet of rock and finally cleaned out and seated under air. The caissons for pier 11 were sunk through 28 feet of water and 65 feet of coarse river sand containing some silt and gravel. It was necessary to maintain 48 lbs. of air pressure in this deepest caisson. That is about the maximum pressure under which men are permitted to work.

Every conceivable protection was taken to protect the workmen, and so far as we know, no one was injured by reason of having worked in the caissons under that pressure. The other piers were minor in size and of more or less standard construction as used for piers on land.

Superstructure

The river crossing, see Figure 1, consists of one 964 foot channel span and two 470 foot anchor spans, a total length of 1,904 feet. These three spans are determinate. The stresses in the truss members are readily determined, since these spans are typical cantilever construction, having a 324 ft. suspended section in the 964 ft. center span, and are more or less a routine engineering problem. For that reason, this paper dwells at greater length on some of the details of design, rather than on the design of the structure itself, even though it is believed that the bridge under discussion has the longest span of any constructed across the Mississippi River.

Main Truss Members

All members, except the majority of the hangers were boxed members in which the cover plates had oblong cutouts, at regular intervals, to provide access for riveting and painting. These holes were 10 x 20 inches except at panel points, where in some cases it was necessary to make them 12 x 24 inches, to allow a man to enter the member during riveting, in which case the member was reinforced to compensate for the additional sectional area removed.

A.A.S.H.O. specifications, which were used in general, require the removal of at least one quarter inch of metal by milling, chipping or grinding in the case of flame cut edges of silicon steel. This is an extremely costly requirement.

The fabricator was permitted to flame out the holes providing the edges were annealed simultaneously by a gas flame. This procedure had previously been used on two other large bridges in which extensive tests were made before the procedure was adopted by the engineers.

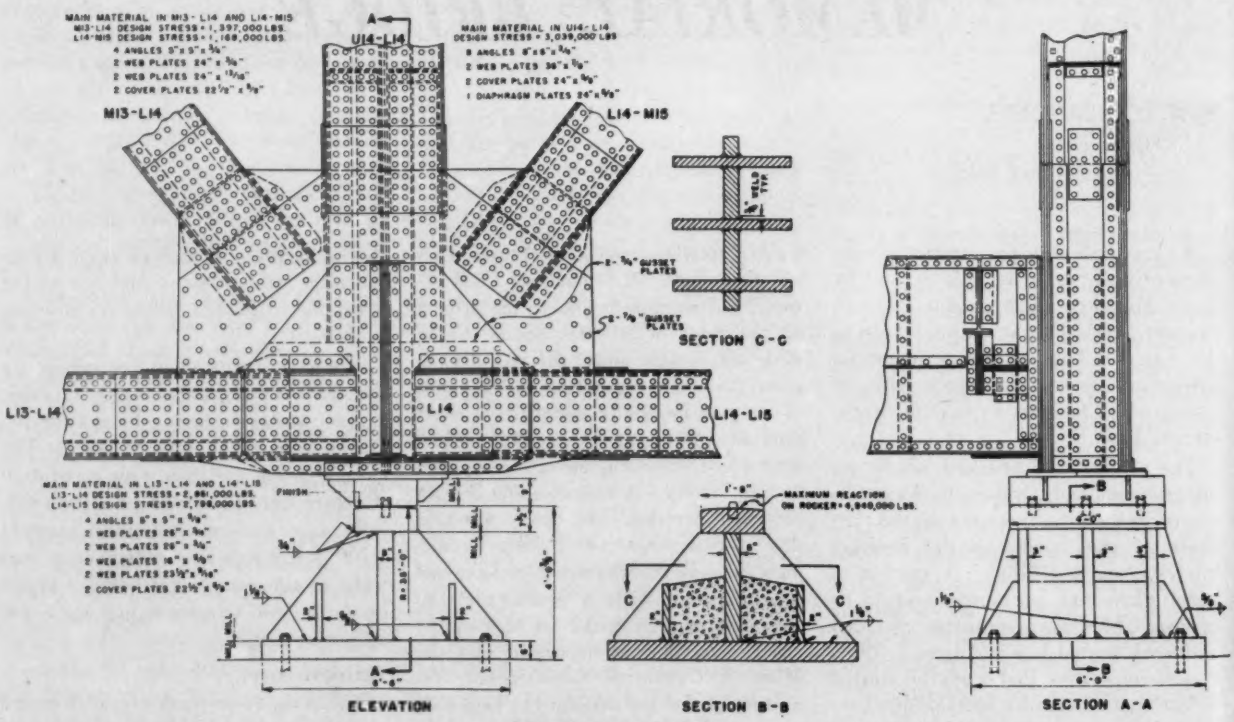
Bridge Shoes

The original design contemplated the use of a shoe on the main piers at panel point L14, in which the members entering the joint were joined by the use of large pins. A study indicated that the bearing pressure would be so great on these pins that rotation could hardly be expected to take place.

Mr. Jonathan Jones, Chief Engineer of the Bethlehem Steel Company, suggested the use of a rocker type of shoe. Study of this problem by both the Bethlehem Steel Company and Hazelet & Erdal, resulted in the development of the shoe shown in Figure 2.

(*Continued on Page* 22)

FIGURE 2


MAIN MATERIAL IN M13 - L14 AND L14 - M15
M13-L14 DESIGN STRESS = 1,397,000 LBS.
L14-M15 DESIGN STRESS = 1,168,000 LBS.
4 ANGLES 5" x 5" x 3/4"
2 WEB PLATES 24" x 3/8"
2 WEB PLATES 24" x 13/16"
2 COVER PLATES 22 1/2" x 3/8"
U14-L14
MAIN MATERIAL IN U14 - L14
DESIGN STRESS = 3,039,000 LBS
8 ANGLES 8" x 6" x 3/4"
2 WEB PLATES 36" x 5/8"
2 COVER PLATES 24" x 9/16"
1 DIAPHRAGM PLATES 24" x 9/16"
M13-L14
L14-M15
2 - 3/4" GUSSET PLATES
2 - 7/8" GUSSET PLATES
SECTION C-C
L13-L14
L14
L14-L15
MAIN MATERIAL IN L13 - L14 AND L14 - L15
L13-L14 DESIGN STRESS = 2,861,000 LBS.
L14-L15 DESIGN STRESS = 2,798,000 LBS.
4 ANGLES 8" x 8" x 1"
2 WEB PLATES 26" x 3/4"
2 WEB PLATES 26" x 3/4"
2 WEB PLATES 16" x 5/8"
2 WEB PLATES 23 1/2" x 5/8"
2 COVER PLATES 22 1/2" x 5/8"
FINISH
MAXIMUM REACTION ON ROCKER = 6,840,000 LBS.
ELEVATION
SECTION B-B
SECTION A-A

ROCKER BEARING AT L14

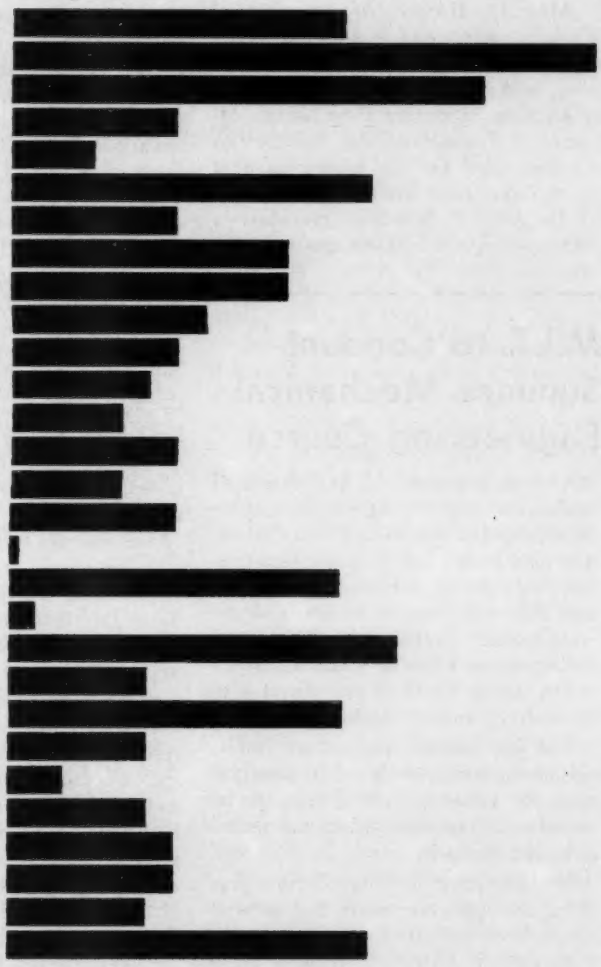
AT THE CLUBHOUSE TURN

THE MEMBERSHIP FARMS ENTRIES ARE RUNNING SMOOTHLY

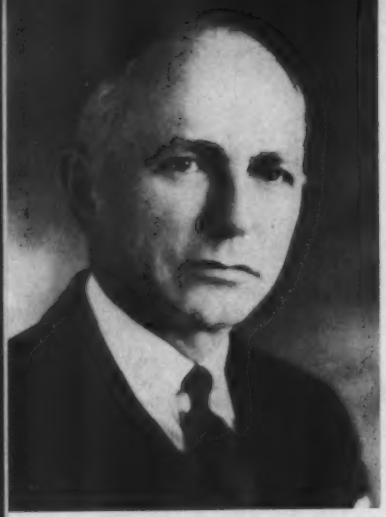
214 APPLICATIONS (AS OF APRIL 3)

SCRATCH SHEET

Post Position	Entry	Jockey	Running Form
1.	Abbott, F. J. to Bailey, G. G.	Cluts, Sam	12
2.	Bailey, C. R. to Benson, E.	Merrill-Bolten	21
3.	Benson, R. L. to Bradley, B. H.	O'Leary, Tim	17
4.	Bragdon, H. B. to Caldwell, J., Jr.	Maihock, Don	6
5.	Calek, J. F., Jr. to Conrad, N. J.	Benoit, Bill	3
6.	Contos, P. G. to Dencer, F. W.	Pearson, Harold	13
7.	Dening, R. P. to Erickson, H. A.	Judd, Jim	6
8.	Ericson, R. T. to Fox, E. G.	Sanderson, Sandy	10
9.	Fox, J. P. to Goss, H. A.	Gibson, Floyd	10
10.	Gossett, E. J. to Hansen, R. H.	Dinsdale, Dave	7
11.	Hanson, C. D. to Hewitt, E. E.	Foley, Jim	6
12.	Howson, J. F. to Idaszak, L. R.	Miller, Charles	5
13.	Imhoff, E. A. to Kaar, H. W.	Laning, Lorence	4
14.	Kahan, L. to Koepke, H. F.	Dare, Jim	6
15.	Kohout, G. W. to Larson, P. L.	Urbain, Leo	4
16.	Larson, P. J. to Lunos, I.	Hikes, Burd	6
17.	Lurie, B. L. to Mann, L. B.	Reed, Ken	0
18.	Manning, J. V. to Mittlemann, E.	Byrnes, Tom	12
19.	Mitten, G. R. to Newling, L. H.	Wessling, Dick	1
20.	Newman, H. L. to Paulson, R. A.	Wilke, Ray	14
21.	Pearl, A. S. to Przyseicki, T. I.	Tansey, John	5
22.	Purcell, T. V. to Rogers, D. E.	Goodell, Floyd	12
23.	Rogers, E. to Scapin, J. F.	Briggs, Jim	5
24.	Schad, J. A. to Schapiro, B. B.	Barlow, Jim	2
25.	Sharring, F. A. to Spake, L. C.	Schuster, J. V.	5
26.	Spalding, F. W., Jr. to Suson, I.	Brandon, Cliff	6
27.	Sutherland, W. L. to Vallette, F. F.	Kucho, Joe	6
28.	Valonis, E. J. to Wegener, E. C.	Prentiss, Ed	5
29.	Weicker, P. C. to Wisner, J. F., Jr.	Mehl, Fred	13
30.	Wisner, J. F., Sr. to Zwerg, H. R.	McConochie, Bill	4



LET'S GALLOP THE HOMESTRETCH TOGETHER



Alex D. Bailey, *life member of Western Society and former vice president of Commonwealth Edison Company, who received an honorary Doctor of Engineering degree from Illinois Institute of Technology March 27, 1952. He was cited for his accomplishment as engineer, civic leader and executive by Dr. John T. Rettaliata, president of Illinois Tech, who conferred the degree.*

M.I.T. to Conduct Summer Mechanical Engineering Course

New developments in five phases of mechanical engineering will be emphasized in special courses in Metal Cutting, Internal-Combustion Engines, Lubrication Engineering, Vibration, and Industrial Photoelasticity to be given at the Massachusetts Institute of Technology during the summer of 1952, according to Dr. Ernest H. Huntress, Director of the M.I.T. Summer Session.

The five courses, part of an M.I.T. summer program designed to meet the needs of industry, will devote special attention to machine design and manufacturing methods.

In announcing the comprehensive program, the Institute noted that present demands on industry emphasize the importance of choosing manufacturing conditions intelligently and expediently. To this end, these special courses in mechanical engineering will be based on the latest information derived from research and industrial practice.

The course in Metal Cutting, planned especially for those in industrial production, will be given from May 26 to June 6. Emphasis will be on presenting a unified picture of the metal cutting process in terms of recently developed fundamental principles.

Topics will include atomic structure and physical properties of metals; mechanics of cutting; plastic flow of metals during cutting; role of cutting fluids in reducing tool friction and wear; machinability and tool life; thermal aspects of cutting; metallurgical aspects of machining, grinding, honing, and polishing; and three-dimensional cutting processes.

The program in Internal-Combustion Engines from June 9 to June 20 will emphasize the analytical approach to performance and design problems and to the planning and control of experimental and development programs. It is planned primarily for the engineer responsible for the design and development of improved models of Diesel or Otto-Cycle engines, and for the teacher of these and related subjects.

The course will be under the direction of C. Fayette Taylor, Professor of Automotive Engineering and Director of the Sloan Laboratories for Automotive and Aircraft Engines.

Lectures in the course will be followed by discussion periods and in many cases by laboratory demonstrations as well as by conducted visits to related laboratories, including those for experimental stress analysis, dynamic strength of materials and gas turbines.

A specialized program in Lubrication Engineering will be offered from June 23 to July 3 to provide an opportunity for engineers in industry to study the application of new techniques and methods in this field.

Designed primarily for the engineer responsible for lubrication maintenance and scheduling in an industrial plant and for engineering students who are interested in taking advantage of the growing demand for men trained in this area, the program has the sponsorship of the American Society of Lubrication Engineers and other technical groups.

The course will be under the direction of Professor Brandon G. Rightmire, Assistant Professor of Mechanical Engineering and in charge of the M.I.T. Lubrication Laboratory. He will be assisted by other engineers from the Institute's staff and by representatives from industry.

Newest developments in the field of vibration will be reviewed in a special two-week course offered by the Department of Mechanical Engineering and Aeronautical Engineering from August 4 to August 15.

The program will be under the direction of Professor Jacob P. Den Hartog, who has specialized in the general field of vibration for 25 years and who is in charge of the Applied Mechanics Division of the Mechanical Engineering Department.

In commenting on the significance of the course, Professor Den Hartog noted especially the radical change in instrumentation requirements created by the trend toward higher and higher frequencies in mechanical vibrations of machinery, particularly in engine torsionals and in turbine blading. He also pointed out that extensive knowledge of vibration is very desirable to an understanding of the field of servomechanisms.

Because of the increasing need for formal instruction in the photoelastic method of stress analysis, a special two-week course in Industrial Photoelasticity will be offered from August 18 to August 30.

Designed primarily for the practicing engineer with no previous knowledge of the subject, the course will be under the direction of Professor William M. Murray, who is in charge of the Laboratory of Experimental Stress Analysis.

Included in the program will be a survey of the field of photoelasticity and its uses and a discussion of experimental techniques and equipment. Emphasis will be placed on the application of the photoelastic methods of stress analysis to industrial problems.

All facilities of the Institute will be open to members of summer session courses. Living accommodations will be available in M.I.T.'s Alfred E. Burton House, overlooking the Charles River Basin and the Boston skyline, to those who specifically request reservations in their applications for admission.

Early application is advisable since enrollment in all courses is limited. Requests for application forms or for further information on these and other special summer activities at M.I.T. should be addressed to Dr. Ernest H. Huntress, Director of the Summer Session, Room 3-107, Massachusetts Institute of Technology, Cambridge 39, Massachusetts.

The Postal Transportation Service

CHARLES W. REAMES
General Superintendent
Postal Transportation Service, 6th Division

THERE is no other business or government bureau that so vitally affects every man, woman and child of our great nation as the Post Office Department. The Post Office Department today is the world's largest public utility. It is the good samaritan always present in all highways of the land giving the same service to all patrons. Like most things that are completely a part of our lives, dependable postal service is generally taken for granted.

The Hon. Jesse M. Donaldson, Postmaster General, a cabinet member, is ably assisted by four assistant postmaster generals in conducting the many correlated functions of the department. Each assistant is head of one of the four bureaus: Bureau of Operations, Bureau of Transportations, Bureau of Finance and Bureau of Facilities.

We will consider the Bureau of Transportation under the direction of Hon. John M. Redding who is assisted by an executive director and two assistant executive directors.

For a century the transportation of the mails was a prerogative and inherent right of the railroads and their subsidiaries. With the close of World War I, the truck and airplane entered the field as competitors. The speed of the plane and the go-anywhere flexibility of the truck were quickly recognized in commercial transportation. Neither carrier at that time, however, offered much advantage and no competition in carrying the mail. The railroads continued to move the greater bulk of the mail because no other form of transportation offered better rates.

It has been only a little more than a century and a quarter ago when the first railroad service was inaugurated, horse drawn over wooden rails. Approximately 120 years ago the first steam locomotive operated in this country. A century ago the Pennsylvania Railroad was building toward Pittsburgh, the B & O headed for the West, the New York Central had reached Albany and was moving west to Cleveland. The Michigan Central, Illinois Central, and Rock Island were extending their lines into new, unchartered territory. At this same time, the farmers in the West were demanding extensive construction of railroads to move more produce to Eastern markets in exchange for manufactured products. The merchants of Chicago were of the opinion that by building railroads, Chicago would lose much of its value as a commercial center since the products would be moved to other points for distribution to the consumer. How much they were in error you now can readily see since Chicago today is without question not only the greatest railroad center in the world but also the greatest air center and destined to be the leading competitive trucking center. Chicago is without question at the cross roads of the world.

In a communication dated July 1, 1864 addressed to George B. Armstrong, Assistant Postmaster at Chicago, Postmaster General Montgomery Blair authorized a test, by actual experiment, upon any railroad selected by Mr. Armstrong, of the plans which the latter had proposed for the distribution of mail in transit. These instructions are generally credited as constituting the initial step in the formation of the Railway Mail Service, since November 1, 1949, The Postal Transportation Service.

It was Armstrong's dream that the Post Office be hitched to the Ironhorse. He saw the tremendous advantage that a mobile post office, effecting rapid pick-up, distribution and delivery of mail en route, would be to the postal system and to the country at large. He was able to see his dream come true.

The first continuous Railway Post Office Service in the United States was established August 28, 1864 through Mr. Armstrong by a directive of Postmaster General Blair on the Galena Division of the Chicago & Northwestern Railway. It operated from Chicago to Clinton, Iowa in a remodeled route agent's car using letter cases borrowed from the Chicago post office. The car was 40 feet long with two windows, oil lamps, side doors but no end doors. The first railway postal car, built by the Northwestern Railway Company according to Post Office Department specifications, was placed in service in 1867 between Boone and Council Bluffs, Iowa. When the advantages of this system became apparent, it was quickly established on other railroads.

The Chicago, Burlington & Quincy Railroad, however, had previously operated a railway post office between Hannibal and St. Joseph, Mo. during September of 1862. A clerk from the St. Joseph Post Office distributed mail en route for immediate dispatch upon arrival of the train to the famous Pony Express and State Coach, without additional expense to the Post Office Department. It was claimed that this eliminated a 24-hour delay in the overland mails.

While most of us are conscious of the great contribution the varied forms of transportation has made in the development of our country, few of us take

the time to realize how directly it has affected all of us.

A little more than a hundred years ago, cities were dependent upon the surrounding countryside for food. When they reached a certain size, they stopped growing because food could not be produced, processed, preserved and transported the ever increasing distances for a greater population.

Today, however, every little country town or village draws upon the whole world for its subsistence. The people of the smallest town in the most remote corner of any state eat wheat grown in the midwest, fruit from Florida, California and Washington, rice from Louisiana and oysters from Baltimore. They wear shoes made in New England and at breakfast read a metropolitan morning newspaper of the same date published 500 miles away which is efficiently and swiftly transported by the Postal Transportation Service.

Volume of Mail

Mail handling is a specialized type of work, involving many complex operations and requiring the services of highly skilled employees. The simplification and improvement of means and methods and the development of skills is a constant objective. It is true that great changes in postal transportation and distribution are in the making. Year by year there has been an increase in production. Since 1940 the productive performance per man-hour has increased 13.52 per cent in the number of pieces handled; a 37.78 per cent increase in pounds of mail handled, and a 14.02 per cent increase in special service transactions handled.

For the 10-year period 1940-50, while revenue increased 118.72 per cent obligations 174.89 per cent, pieces of mail 62.39 per cent, and pounds of mail 97.10 per cent, the number of employees increased only 14.74 per cent. The hours of productive employment increased only 43.05 per cent.

The volume of mail has reached the highest point in the history of the postal service. This has emphasized the problem of increasing terminals and transfer space and mail docks to work loads much heavier than those for which these facilities were designed.

Railroad service which carries a major volume of mail has been curtailed on several occasions in the past by strikes of various origin. The discontinuance of branch line railroads has been accelerated as a result of the strikes because railroads did not care to resume service on unpredictable, unprofitable lines on which operations had been suspended.

Postal transportation did not stand still during the period between the first and second world wars. It did remain very dependent upon rails, for the railroads had no serious competitor for bulk mails. The increase in rail discontinuance, however, was viewed seriously by transportation officials of the Department for many years.

There has been a 65 per cent decrease in the number of mail carrying trains in the last 25 years. In 1925 there were 19,404 trains throughout the country, compared with 6,794 in 1950. In May 1921 there were 137 RPO's and 141 C.P. lines operating in the Sixth Division which is Illinois and Iowa.

This is compared with 66 RPO's and 15 C.P. lines in June 1951. We can safely assume that all these trains were discontinued because of failure to meet operating costs. Railroads have driven more mail traffic to trucks by discontinuance of trains in recent years than the Post Office has done by diverting mails to trucks on its own initiative.

Frequently rail service has been discontinued faster than adequate new truck service could be put into opera-

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tion. During the period of eight months, from January 1, 1951 to September 1, 1951, the Department diverted on its own order from railroad to truck routes, mail traffic for which the rail cost at rates effective prior to February 19, 1947, amounted to $1,673,000 annually.

During the same period the railroads on their own initiative discontinued train service for mail traffic amounting to $1,808,000 annually. The railroads discontinued service July 1, 1949, to December 31, 1950, a period of 18 months, equivalent to $4,112,000. Such procedure has forced the Department to find other means of transportation, either my less advantageous trains or by trucks. This action by the railroads has been going on for several years.

Star Routes

In the event of discontinued train service, it has always been the policy of the Post Office Department to provide, by other means, adequate mail service as good or better than previously enjoyed by patrons. Thus discontinued service of branch line trains was superseded by one or more Star Routes operating over highways from post office to post office, one, two and frequently three or more round trips daily or daily except Sunday, usually exchanging mails between the hours of 6:00 A.M. and 6:00 P.M. Such service was approved by our patrons and was available when scheduled operation of main line trains permitted. Consequently, many Star Routes of varying lengths were established during the past 25 or 30 years.

Rail rates went up sharply effective January 1, 1951. Thus trucking for the short mail now is for the first time less costly than rail. The possibility and even necessity of going to motor vehicles was foreseen in the early 1930's. As a result of future planning done then, the Department was prepared in 1941 to inaugurate the first Highway Post Office route from Washington, D.C. to Harrisonburg, Va. This pioneer route is still in operation, giving postal service where railroads no longer provide either passenger or mail service. Highway Post Offices are, in effect, Railway Post Office cars on rubber wheels, and they transport all classes of mail, including storage mails. There are now 92 Highway Post Office routes in operation performing more than 8 million miles of service each year. They serve 1,886 communities. This is one approach to the serious problem of giving postal service in areas no longer served by railroads. It is not the only answer nor the final one.

There are three types of Highway Post Office Operation: (a) Government owned and operated. (b) Contract Routes on four-year contracts. (c) Railroad owned and operated with negotiated rates.

Two contract HPOs are operating in Iowa. A railroad owned and operated HPO Chicago to St. Louis, by the G M & O Railroad, began operation on February 1, 1952.

The first railroad owned and operated HPO, G M & O Railroad as Contractor and the Gulf Transport Company performing the service, was established November 11, 1951, between Jackson, Miss. and Mobile, Ala.

The new rate structure, effective January 1, 1951, for mail carried by railroads provides for two charges against the mail; a line haul charge and a terminal charge for loading and unloading. The old rail rate, in effect previous to January 1, 1951, had been favorable to short haul mail. This is not true of the new 1951 rate. The terminal charge alone greatly increased the short haul cost.

The United States mail could no longer go without question and justification by rail—at the higher cost. A sharp definite break with long accepted custom was necessary. Never again should the transportation of mail be irrevocably the inherent right of any one common carrier industry.

A new mail-by-truck pattern is now in the making. No longer can any one carrier, whether rail, truck, or air, transport the mail as a "right." The new program gives improved service for bulk mails (largely fourth-class matter) with a lesser number of handlings, eliminating by the same ratio the possibility of damage, in 34 metropolitan areas, and direct service between many larger cities.

Trucking is dependent upon good terminal space. Obtaining usable and adequate terminals has been difficult but considerable progress has been made on two fronts: (1) Establishing new facilities by construction, remodeling, lease or other arrangement. This has been done at Chicago, St. Louis, Columbus, Birmingham, Boston and Cleveland. (2) Making available post office dock space during night hours for trucking. Doubling up in this manner has opened up a number of the new routes.

Postmasters have given their cooperation, realizing the benefits in expediting bulk mails. The Department is actively searching for more truck terminal space in many cities. The trucking program's future progress is bound up very closely with acquiring expanded terminal space.

The search for a long-range solution to the problem was intensified in 1947 when the railroads petitioned for rail rate increases. Likewise, other large shippers were looking for answers to the same problems. Meanwhile trucking in two decades had grown to a $3,500,000,000 a year business in intercity trade by 1950.

Advantageously using every form of economical progressive transportation, the Post Office Department has been able to hold back rising costs and give improved service. In every case where mail has gone from rail to highway truck, delivery has been expedited.

Our representatives in the St. Louis area, with 17 mail truck routes, reports an average 16 hour advance in delivery. Trucking is an all-postal operation. Aside from the economy of direct line cost and handling charges, mail by truck has other characteristics: elimination of such side services as mail messenger service, motor vehicle service and screen wagon service; greatly reduced number of handlings, less damage enroute; speedier service over the road; operating schedules set by and for the needs of the Postal Service, and payment for the load hauled on the truck and no more.

Comparison of Costs

Mail by truck is an effective competitor of rail and this is only a beginning. Diversion from rail to truck for short hauls may curtail operating expenses by $100,300,000. Present rates by railroads would total $273,400,000 as compared with an estimated cost by truck of $173,100,000.

In trucking mails it is not intended to move distribution of all classes of mails from the RPO lines. In this operation the rail is far superior to the short-haul truck line. In the long haul, making distribution enroute, the rail is tough competition. From door to door of post offices throughout our big cities, a truck

(*Continued on Page* 20)

Dr. L. E. Grinter Named Dean of Florida Graduate School

Dr. L. E. Grinter, formerly vice president of Illinois Institute of Technology, has announced his appointment as Dean of the Graduate School and Director of Research at the University of Florida, Gainesville, Fla. At Gainesville, Dean Grinter will assume responsibility for a graduate student body of 1500 students and a research program involving an expenditure of several million dollars annually. He expects to take up his new duties at the beginning of the fall semester. For the past two years Dr. Grinter has been consultant to the Board of Control for Southern Regional Education and is now a member of the Board's Commission on Graduate Studies which has its headquarters in Atlanta, Georgia.

Dr. Grinter came to Armour Institute of Technology in 1937 to organize the graduate school and to serve as its first dean. With the merger of Armour and Lewis Institutes he became the first vice president of Illinois Tech and was responsible from 1940 to 1946 for the Institute's coordinated educational and research program. During this period Illinois Institute of Technology developed its College of Liberal Arts, its Extension Division for educational cooperation with industry, its scientific research options, its management options, and its industrial safety program. Several major departments were also established including metallurgical engineering, naval science, biology, food engineering and psychology including the Institute for Psychological Services. The distinction of the faculty assembled under the leadership of Dean Grinter has attracted national attention.

Dr. Grinter

Since 1946, Dr. Grinter has been research professor of civil engineering and mechanics at Illinois Tech. He has also served as chairman of the Panel on Equipment and Construction for the Department of Defense in Washington. In this work he has had the assignment of developing cooperation between the Army, Navy and Air Force in the field of research. Since 1948 he has been a consultant to the Research and Development Board in Washington on the resistance of structures to atomic explosions. His professional activities have taken him to Europe and to the island bases of the Pacific area.

The writings of Professor Grinter include numerous scientific monographs and a half dozen books in the fields of structural engineering and mechanics. He also writes articles on graduate and undergraduate education. Under his direction two major committee reports are now approaching completion—one is a study of graduate education and the other a report on improvement in the teaching of undergraduate students. He is at present vice-president of the American Society for Engineering Education. In this society he was responsible for the organization of the Graduate Division and served as its first chairman.

Among other activities under the sponsorship of Illinois Tech that have been initiated by Dr. Grinter during his stay in Chicago is the Midwest Power Conference which annually since 1938 has drawn several thousand engineers to Chicago for technical meetings and broad discussion of the nation's power problems. Dean Grinter also stimulated the establishment of the National Conference on Industrial Hydraulics and the Mechanics Colloquium of Illinois Tech. When you telephone the Institute and the operator answers "Technology Center," you are listening to a name attached to the campus by Dean Grinter more than a decade ago. For a number of years the name "Technology Center" received little use, but as activities expanded this name became generally accepted as the clearest way to explain briefly the associated activities at the South Side campus of the Institute.

Dean Grinter is a member of a dozen societies and organizations in each of which he has served almost continuously as chairman of one committee or another. He has been Chairman of the Washington Award Commission representing six associated engineering societies and is at present a trustee of the Western Society of Engineers. Through such organizations Dr. Grinter has been active in civic work and has made recommendations concerning possible solutions to such vital problems of Chicago as traffic improvement, the new building code, slum clearance projects and reindustrialization of depressed areas. During the past year his calendar showed attendance at 125 meetings of a technical or civic nature plus a semi-monthly trip to Washington.

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Committees List Candidates for Section Directors

The Nominating Committees of five sections have nominated two members each as the regular ticket for Directors of these sections for a term of three years beginning June 1, 1952.

Nominees for the Traffic Engineering and City Planning Section are:

Mrs. E. Frances Barnett, structural designer, Department of Filtration Design, City of Chicago.

George L. Jackson, engineer of expressways, Illinois Division of Highways.

Nominees for the Bridge and Structural Engineering Section are:

Frank A. Randall, Jr., partner, Frank A. Randall and Sons.

Theodore W. Van Zelst, president, Soil Testing Services, Inc.

Nominees for the Communications Engineering Section are:

Edward T. Baldwin, department chief, Teletype Corporation.

Daniel E. Clark, research physicist, Automatic Electric Co.

Nominees for the Electrical Engineering Section are:

Francis A. Cox, assistant to electrical engineer, Public Service Company of Northern Illinois.

Clyde E. Giller, building plans and specifications engineer, Illinois Bell Telephone Co.

Nominees for the Gas, Fuels and Combustion Engineering Section are:

James H. Erwin, gas division superintendent, Central Illinois Electric & Gas Co.

Ralph A. Munkers, manager of electric production, Public Service Company of Northern Illinois.

New directors of two WSE sections were elected at recent meetings. They are:

Transportation—Ralph F. Gross, transit and traffic engineer, City of Chicago; B. M. Kostenko, metallurgist and office manager, Sueske Brass and Copper Co.

Chemical and Metallurgical—A. Allan Bates, vice president, Portland Cement Association; John P. Gnaedinger, secretary-treasurer and director of Soil Testing Services, Inc.

Other Corporate Members may be nominated by petition signed by 10 Corporate Members of the Society, provided acceptance of these nominees has been secured in writing.

Directors of the sections will be elected at the section meeting: April 14.

Traffic Engineering and City Planning Section—April 28.

Bridge and Structural Engineering Section—May 19.

Electrical Engineering Section—May 26.

Chicago Safety Council to Sponsor Annual Show

All industrial safety men in the Chicago area will play an active part in the forthcoming 29th Annual Midwest Safety Show sponsored by the Greater Chicago Safety Council and cooperating agencies at the Congress Hotel, Chicago, on May 5, 6, 7 and 8.

Industrial meetings for supervisors, foremen, safety directors, and general plant personnel will feature sound practical information on civil defense, industrial relations, the problem of noise in industry, commercial vehicle operations, construction, training, fire prevention, material handling, electricity, industrial hygiene and many others.

Among the cooperating agencies who will hold meetings at the Show are the Cook County Traffic Safety Conference, the Illinois State Nurses Association, industrial nurses section, the American Society of Safety Engineers, the regional meeting of the Association of American Railroads, and the Civil Defense Conference.

Additional session titles include: The Petroleum Industry Looks to Safety, and Planning Safety in Confectionary Plants.

One of the highlights of the affair will be the awarding of safety plaques in the Council's industrial and commercial vehicle accident prevention contests at special dinners on May 5 and 6.

Attendance at the Safety Show reached an all time high of 6,576 in 1951, according to Joseph F. Stech, manager of the Council. Sixteen states and 832 companies were represented at the 1951 Show.

John J. Ahern, (WSE) director, Department of Fire Protection and Safety Engineering, Illinois Institute of Technology, is program chairman, and B. M. Livezey, general superintendent, South Works, U. S. Steel Corporation, is general chairman of the event.

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WSE Personals

Walter R. Zimmer, member of WSE, now is associated with the Chester Johnson Electric Co. in Chicago. Mr. Zimmer formerly was an estimator with Electrical Contractors, Inc.

Jack A. Scanlan, *structural engineer* and associate member of WSE, has *joined the staff of Ralph H. Burke, Consulting Engineers in Chicago, and now is in charge of the firm's structural engineering department at O'Hare Field in Bensenville. Mr. Scanlan took the place of E. A. Randall who retired March 15.*

Dr. Gustav Egloff attended the national spring meeting of the American Chemical Society (Organic Division) at Buffalo, N.Y., from March 23 to 26. At that time he appeared on radio station WKBW in a panel discussion on synthetics from petroleum. From March 30 to April he attended a meeting of the Western Petroleum Refiners Association in San Antonio, Texas. On April 4, Dr. Egloff went to Monterrey, Mexico to address the Monterrey Institute of Technology. Title of his speech was "Catalysis in Petroleum Refining."

On April 16, he will attend the National Petroleum Association meeting in Cleveland. On April 22, Dr. Egloff will give a talk before a joint meeting of the Illinois Society of Certified Public Accountants and The Robert Morris Associates, Chicago. Title of the speech is, "The Impact of Inventive Genius." On April 28, he will address the Cornell Society of Engineers on "The Modern Oil Industry."

Arthur M. Kaindl, WSE member and formerly a structural engineer with the City of Chicago, now is with the A. J. Boynton Co.

Vern E. Alden Company, Engineers has announced the removal of the offices from 120 S. LaSalle St., Chicago, to 33 North LaSalle St. The new phone number of FRanklin 2-1620.

Carl A. Anderson, WSE, has been elected 1952 president of the Chicago Chapter of the Illinois Association of Highway Engineers. A civil engineer, Mr. Anderson has been associated with the Illinois Division of Highways for the past 12 years.

Alan Bate, WSE member, has moved to Fostoria, Ohio, where he now is assistant general manager of the Bersted Manufacturing Co., Division of the McGraw Electric Co. Mr. Bate had been managing engineer of the Chicago Electric Manufacturing Co.

Leon D. Urbain, a structural engineer with Hazelet and Erdal for several years, has recently joined the firm of Consoer, Townsend & Associates where he will head their industrial plant division.

Mr. Urbain is well known to many WSE members through his work with the Civic Committee during the past six years. This year he is also a team captain for the membership committee.

Joseph H. Skelton, WSE, now is associated with the Harza Engineering Co. in the Mechanical Division. Mr. Skelton had been a mechanical engineer with the Vern E. Alden Co.

Francis G. Varenhorst, member of WSE and AIEE, has been appointed chairman of the Special Gifts Committee for the 1952 Alumni Fund program at the Illinois Institute of Technology. Mr. Varenhorst, the honor man of the 1931 class, is in the engineering division of the Illinois Bell Telephone Co.

During the early years of the war he assisted in the department of education of the State of Illinois in its instructor training division. He also served as an instructor in the evening division of Illinois Tech in courses in industrial management. In 1943 he was transferred to the Bell Laboratories, acting in various administrative engineering capacities both in the Chicago area and in the East.

While working in the East, Mr. Varenhorst was initiated into the Stevens Institute chapter of Tau Beta Pi, honorary engineering fraternity, in recognition of his outstanding engineering achievements.

Howard R. Olson, a member of Western Society since 1928, has been named General Manager of the Chicago Regional Planning Association through appointment by its Board of Directors on February 26, filling the position made vacant by the death of Robert Kingery on November 13, 1951.

A graduate civil engineer of Iowa State College, Mr. Olson had engineering and construction experience in municipal development, buildings and state highways before joining the association in 1925 when the staff was organized under Mr. Kingery.

Mr. Olson has had wide experience in the Association's work in municipal, county and regional planning and zoning in the suburban metropolitan area, including service in his own village of Riverside as chairman of both the plan commission and zoning board of appeals.

Dan J. Iverson now is a member of the Maintenance of Operation Department of the Arthur Rubloff & Co. Mr. Iverson had been an engineer with the L. J. Sheridan & Co.

Edward J. Wolff, a member of WSE, has announced that he has established a mechanical and electrical consulting engineering office at 9 S. Clinton St. in Chicago. Mr. Wolff was vice president of the Electric Service Engineering Company.

CORRECTION

Frank Miller, an affiliate member of WSE, was unintentionally omitted from the membership listing in the 1951-52 Yearbook. Mr. Miller is supervisory clerk with the Illinois Bell Telephone Co.

Crerar Library
Notes and News

The Chicago Chemical Library Foundation has made very substantial grants to Crerar for chemical literature in 1952, totalling approximately $7,000. Coverage of current foreign books and an extended list of periodical subscriptions were both renewed for the year. New titles were added to the subscription list and purchase of a large number of recent books, which have been missed in the recent acquisitions program, was also approved. And a special appropriation was included to help the Library complete sets of several hundred periodical titles already represented in the collections.

This contribution to the technical research facilities in Chicago is of the greatest importance. Without this aid, Crerar would have a good research library in chemistry. With the aid, the collections are becoming a superlative resource for chemical research.

* * *

Chicago editorial offices of *Chemical and Engineering News* and *Industrial and Engineering Chemistry* will be established in room 403 of the Crerar Library Building, 86 East Randolph Street, by the first of April, 1952. These offices are important additions to the Science and Engineering Center in which WSE and Crerar Library have a mutual interest.

The role of the science library increases in importance with the increased emphasis on research. The level of emphasis reached in 1952 is made startlingly clear by statistics in the first annual report of the National Science Foundation. At the start of the recent war, the annual rate of expenditures in the United States for scientific research and development approximated $800 million. The above report estimates 1952 expenditures at $2,930 million, an increase of 360 per cent. Industry supplies about 44 per cent of the total national research money, and expends more than 60 per cent, the balance coming from federal sources.

* * *

Members of WSE will be interested to know that the correspondence of Octave Chanute relating to aviation is being edited at The Library of Congress for publication. As an aid to this project, parts of the Chanute collection which are in the Crerar Library will be microfilmed at The Library of Congress. The publication of the Chanute correspondence is part of the large project for publishing the private papers of the Wright Brothers, with whom Chanute had extensive correspondence.

Obituaries

Thomas M. Harris, a member of WSE and district sales engineer for the Link Belt Co., died November 27, 1951. Mr. Harris was a member of the Educational Committee.

George B. Massey, a member of WSE since 1919 and a life member since 1949, died March 9. An outstanding consultant in the fields of hydraulic, sanitary and municipal engineering, Mr. Massey had served on the Board of Direction, as a trustee, from 1939 to 1942. At the time of his death, he was a member of the Washington Award Commission.

Hjalmar Petersen, retired structural and architectural engineer, died February 22. Mr. Petersen joined Western Society in 1920 and became a life member in 1950.

Edward A. Dougherty, chief engineer of the New York Central System in Chicago, died February 27. A member of WSE since 1941, Mr. Dougherty had been employed by the railroad since 1905. He received his degree in civil engineering in 1910 from the School of Mines at Columbia University.

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Twelve Chairmen Named for Centennial of Engineering

Twelve of the nation's leading engineers were named today to act as chairmen for the special general meetings comprising the convocation period of the Centennial of Engineering to be held in Chicago this summer.

The convocation, which is scheduled from September 3 to 13, is expected to bring more than 25,000 leaders in American and foreign engineering bodies to Chicago. Already 51 American groups comprising practically all phases of engineering are pledged to participate in the convocation program, together with nine foreign societies from Great Britain, France, Japan, India, Mexico and Canada. The convocation general meetings will be in addition to the more numerous technical meetings planned by the individual societies.

Other Centennial features, including a dramatic presentation depicting man's technical progress from the days of the cavemen to the harnessing of the atom, and a special exhibit, both to be staged at the Museum of Science and Industry in Chicago, will open earlier in the summer. The latter features are planned primarily for the general public and are expected to be seen by more than a million visitors. They will portray the key factors that have contributed most to the high standard of the American way of life.

The 12 convocation session chairmen, as announced by Lenox R. Lohr, Centennial president, and the engineering subjects to be covered under their respective leaderships, are:—

Food—Clarence Francis, Chairman of Board, General Foods Corporation, New York, New York

Tools—Kenneth M. Condit, Dean, School of Engineering, Princeton University, Princeton, New Jersey

Structures and Construction—Waldo G. Bowman, Editor, Engineering News-Record, 330 West 42nd Street, New York 18, New York

Transportation—Charles F. Kettering, Research Consultant, General Motors Corporation, Box 188, North End Station, Detroit, Michigan

Mineral Industries—Clyde E. Williams, Director, Battelle Memorial Institute, Columbus, Ohio

Chemical Industries—F. J. Curtis, Vice President, Monsanto Chemical Company, St. Louis, Missouri

Communications—William H. Harrison, President, International Telephone & Telegraph Company, 67 Broad Street, New York 5, New York

Energy—Eugene Ayres, Technical Assistant to Executive Vice-President, Gulf Research and Development Company, Pittsburgh, Pennsylvania

European Chemists Meet

The largest exposition of chemical apparatus and equipment to be held in Europe since the war, and possibly the largest of its kind ever held, will occur in Frankfurt am Main, Western Germany, May 18-25, 1952, under the auspices of DECHEMA (Deutsche Gesellschaft fur chemisches Apparatewesen). The 25th International Congress of Industrial Chemistry will be held in conjunction with the Exposition, as well as meetings of a number of other related organizations, which are together forming a "European Convention of Chemical Engineering." Some 15 well-known European technical and scientific socicties are participating in this convention.

Copies of the final program of events and other information may be obtained from the office of the National Chemical Exposition, 86 East Randolph Street, Chicago 1, Illinois.

Oil Reserves Discussed at ASME Spring Meeting

California oil reserves are considered inadequate to supply steadily mounting Pacific Coast demands which already have outstripped present production in the California oil fields, and are due to be supplemented with oil from the gushing wells of Alberta, Canada.

This was disclosed at the spring meeting of The American Society of Mechanical Engineers in the University of Washington, by D. L. Roberts, vice president, Canadian Bechtel, Ltd., Vancouver. He said oil discoveries in the Province of Alberta have continued steadily throughout the past five years until now it is necessary that new markets be found if the present supply is to be fully utilized and further exploration not retarded.

The black gold of the western Canadian prairies, at present locked behind the Rockies, will be brought through passes in the mountains by a 700-mile pipeline from Edmonton to Vancouver, British Columbia, to be completed by the end of 1953. Construction of the 24-inch pipeline is scheduled to start sometime in the early part of this year. It will be built by Trans Mountain Oil Pipe Line Co.

At completion, the pipeline will be able to deliver 75,000 barrels per day to Vancouver. By adding four more pumping stations to make a total of six, a capacity of 200,000 barrels per day can be achieved.

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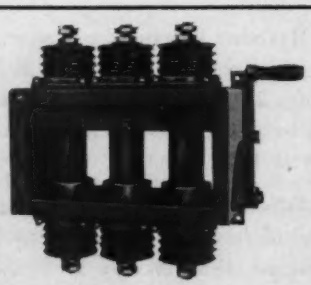

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1954 in British Columbia is only 37,500 b.p.d., a glance at the oil situation in California, Washington and Oregon will indicate the very strong probability that throughput will be increased substantially beyond that volume soon after the line is put in operation and that the ultimate capacity may be reached in a comparatively short time," Mr. Roberts declared.

Dr. Rettaliata to be Installed May 22

Dr. John T. Rettaliata will be inaugurated as president of Illinois Institute of Technology May 22, James D. Cunningham, chairman of the board of trustees of the Institute, announced recently.

A faculty-trustee committee, of which Lester Armour, trustee, is chairman, has been appointed to plan the inauguration. The day-long inaugural ceremonies will include a luncheon for delegates on the Technology Center campus, an afternoon convocation in the Civic Opera auditorium, and a reception and dinner at the Conrad Hilton hotel.

Dr. Rettaliata is the second chief executive of Illinois Tech. The college was formed in 1940 through the merger of Armour Institute of Technology, organized in 1892 by Philip Danforth Armour, and Lewis Institute, founded in 1896 under provisions of the will of Allen C. Lewis.

LETTER OF THANKS

Dear Mr. Becker:

With the close of the first American Power Conference, I would like to take this opportunity to thank you and the Western Society of Engineers for the excellent cooperation which we received.

I think you will agree that the Conference was a highly successful one. We appreciate the activities of your organization on behalf of the Conference and trust that you will convey our thanks to the members of the Society.

Sincerely yours,
R. A. Budenholzer
Director

An authority on jet propulsion, Dr. Rettaliata joined the Institute faculty in 1945. He succeeded Dr. Henry T. Heald, now chancellor of New York university, last month.

Dr. Egloff Named Honorary Chairman of Chemical Art Show

Dr. Gustav Egloff, director of research for Universal Oil Products Company, has been named honorary chairman of the Second International Art Exhibit planned as part of the Seventh National Chemical Exposition.

The Exposition, biennial parade of chemical progress, will be held in the Chicago Coliseum Sept. 9-13, 1952. The art exhibit, limited to the work of chemists, was first staged in 1950 as a part of the sixth exposition. Seymour Goldfarb, Scientific Oil Compounding Company chemist and a modernist painter in his own right, served as the original chairman and will again have active charge this year.

Dr. Egloff's duty as honorary chairman will be to attract as many exhibits as possible. He is one of the best known men in chemistry, both in this country and in Europe. He is a fellow of the Royal Society of Art of Great Britain.

At the first exhibit, chemists in the Argentine, France, England and Austria entered work, along with eighty Americans to bring the total entries to 175. A jury of well known experts will judge the show and award prizes.

The exhibit is open to work in oils, temperas, water colors, drawings and prints. Photographs are not accepted. Each exhibitor may enter two works. Entry cards may be obtained from the National Chemical Exposition, 86 East Randolph St., Chicago.

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(*Continued from Page* 13)

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Some of the trucking members shook their heads in grave doubt when the first truck mail routes were bid in at around 30 cents a mile or less. Some of the big city routes went up as high as 79 cents a mile. Conditions in the local area set the competitive pattern and it varies widely.

There is nothing experimental about trucking when it moves the mail faster and holds down ever rising transportation costs. Short-haul trucking is a cool headed business decision to put the mail over the road at greater advantage to the Postal Service.

Air Mail Service

Communications has been one of the greatest instruments of civilization. Human progress itself can be measured by the development of systems of communications. In this development the Postal Service has certainly played an important part. The day of the humble beginning of the airplane in 1903 at Kitty Hawk; the experimental air mail flights at Mineola, N. Y., 1911; the inauguration of air mail service between Washington, D.C. and New York City in 1918 and the beginning of transcontinental night flight, all are memorable mileposts in the development of our air service.

More air mail passes through the postal facility at Midway Airport in Chicago than any other commercial airport in the world. During the month of December 1951, 2,765,822 pounds of air mail were handled. In 1936 only 2,730,980 pounds were dispatched during the entire year. There are approximately 250 men assigned to the field in Chicago to perform air mail distribution and handling.

Large metropolitan areas present a problem in dispatching mail to and from the airport. In numerous instances the time saved in sending mail long distances by air is lost by the time consumed in surface transportation. It was thought that the helicopter, because of its ability to hover or land in a small area, on the ground or rooftop, might be the solution of the problem. Tests were conducted in Los Angeles and Chicago in 1946 and New York City in 1947. As a result of these tests, helicopter service was established in Los Angeles area on October 1, 1947, which subsequently has been expanded to 50 cities in the Los Angeles metropolitan area.

Chicago helicopter service is authorized to operate with a 50-mile radius of the Midway Airport and during daylight hours only. There are four segments or routes of the helicopter service. Three segments serve Chicago and outlying suburbs of the north, west and south sides. The fourth, known as the shuttle service, provides for 18 round trips between Midway Airport and the Chicago Post Office except on Saturday and Sunday. Seven round trips are made on Saturday morning. In all, 50 cities are served through 33 helicopters.

During the summer months it is necessary to utilize five helicopters in the evening to gather air mail from suburban communities for delivery to the Chicago airport. This load varies from 1600 to 1800 pounds total for the five ships.

Trips are scheduled in the morning hours to leave the airport as late as possible but to arrive at each community in sufficient time to deliver the airmail to the post office to connect city-wide letter carried delivery. The noon trips were originally scheduled to deliver air mail to the suburbs in time to connect city-wide afternoon letter carriers. At the present time they are connecting the last delivery of mail to the business districts. The evening trips are primarily scheduled to operate as late as possible during daylight hours to expedite handling of airmail to the Chicago airport from the suburbs.

Terminal Railroad Centers

At large important railroad centers such as Boston, New York, Philadelphia, Pittsburgh, Washington, Atlanta, New Orleans, Fort Worth, Los Angeles, San Francisco, Seattle, Portland, Denver, Omaha, Kansas City and St. Louis, there are terminal railroad post offices. At these terminals the incoming mail is sorted for further distribution to distant states and cities. It is not practicable or possible to distribute all mails enroute. Car space and the fast time of streamlined trains will not permit. The Chicago terminal, with a total personnel of 1200, distributes mail for the states of California, Florida, Idaho, Illinois, Indiana, Iowa, Michigan, Ohio, Oregon, Utah, Washington, Wisconsin, Wyoming and city distribution for Los Angeles, San Francisco, Seattle and New York City.

Reviews of Technical Books

Available at WSE Headquarters

Irrigation Problems

IRRIGATION ENGINEERING, Volume 1, Agricultural and Hydrological Phases, by Ivan E. Houk; John Wiley & Sons, Inc., New York, 1951. 545 pages, $9.00.

One of the best men in the field has written a pleasantly readable and up-to-date book on irrigation engineering. Mr. Houk has so presented the principles, facts and practices of irrigation that they may be well utilized in the development of irrigation and in the maintenance of successful agriculture.

A "solid" engineer of forty years' experience, Mr. Houk emphasizes engineering aspects.

Brief summaries of the results of the more intensive field and laboratory investigations on irrigation completed to date are given, along with references to important source material.

Special attention is devoted to advances made during the last few years on such subjects as soil moisture, wilting conditions, snow surveys, runoff forecasting, return flow, drainage recoveries, use of water by crops, consumptive use on large areas, irrigation efficiencies, quality of water, boron contents, salt constituents, erosion during irrigation, sprinkling irrigation and other improved methods of applying water.

J.C.L., W.S.E.

Descriptive Geometry

Technical Descriptive Geometry, by B. Leighton Wellman. McGraw-Hill Book Company, Incorporated, New York, first edition, 1948. 508 pages. $4.00.

Descriptive geometry has generally been a mysterious subject for many freshman engineers, and the cause of acute distress for some. Now the engineering novice has available a book which endeavors to make the practice of descriptive geometry relatively as easy, automatic, and routine as driving an automobile. Professor Wellman does this by developing his subject in a rational and logical manner, placing the principal accent on thinking and reasoning, rather than on the end point of placing lines on paper. As he unfolds his system of instruction, he leads the student, or draftsman, along step by step from the easiest to the most difficult stages. Probably a sense of structural visualization will help to some degree, as with previous systems of teaching this subject, but every good engineer must be endowed with such sense anyhow.

J.C.L., W.S.E.

Practical Astronomy

Practical Astronomy, by Jason John Nassau. McGraw-Hill Book Company, Inc., New York. 311 pages, $5.00.

This book presents the elementary parts of practical astronomy in a concise, rigorous and teachable manner. This new edition rebuilds and enlarges the author's well-known "Text book of Practical Astronomy."

The material is divided into two parts:

Part I is fundamental, designed for a first course in practical astronomy.

Part II is advanced, presenting knowledge necessary for field work in geodetic astronomy. It describes basic methods for the precise determination of azimuth, time, latitude and longitude, with proofs for all the necessary formulas for the various determinations. The modern astrolabe is fully described in the function of determining the geographic position of the observer.

It has been assumed throughout the book that the observer is in the northern hemisphere.

J.C.L., W.S.E.

Engineering Metals

The Behavior of Engineering Metals, by H. W. Gillett, John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N.Y., First edition, 1951. 395 pages. $6.50.

The author undertakes to present the viewpoint of the metallurgist for those who have not specialized in this field. The book is intended to help in choosing engineering materials.

The first six chapters of the book introduce the basic concepts of metallurgy. The next nine chapters deal with the behavior of the principal commercial metals and alloys. The remainder of the book is devoted to special considerations that may influence the selection of metals and alloys. These include machinability; fabrication techniques; and corrosion, wear, and high temperature resistance. The vital factors of cost and availability are the subjects of the closing chapter.

A bibliography follows each chapter and the appendix presents sources of more detailed information. There is a seven paged author index and a thirteen-page subject index.

H.P.H., W.S.E.

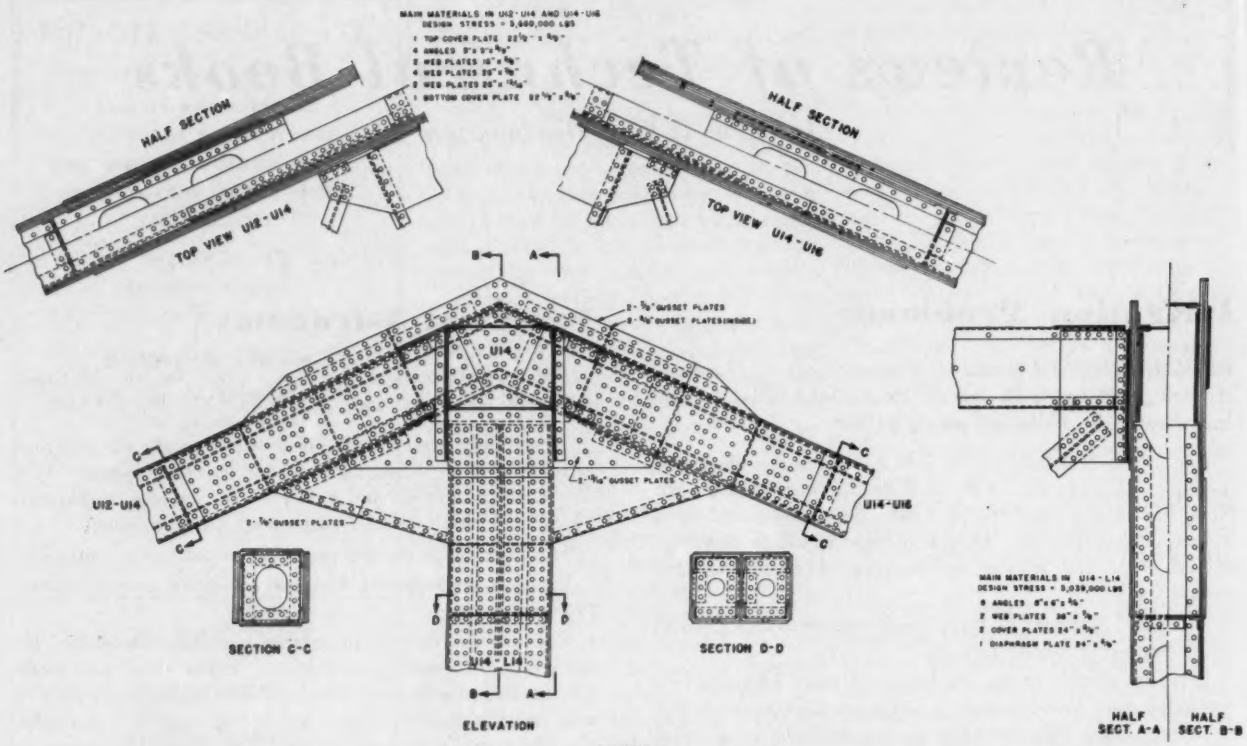

FIGURE 3

(*Continued from Page* 8)

This shoe is subjected to a total load of 4,840,000 pounds. The radius and face width were proportioned on the basis of Professor Wilbur M. Wilson's formula for large rollers, which is as follows:

$$P = (12{,}000 + 80D)\ \frac{(Y - 13{,}000)}{(\ 23{,}000)}$$

where P = allowable load per lineal inch

D = diameter of roller in inches

Y = yield point of material in p.s.i.

"Mayari R" steel was used for the 7½" slab on the top of the bearing and the 9" slab and 1½" sole plate on the truss. The material conformed to ASTM A242, except that it has a specimen yield point of about 45,000 p.s.i. The balance of the shoe was fabricated from material meeting ASTM A7, except that physical tests were waived and the carbon and manganese content specified to lie within .15 to .25 and .40 to .60 respectively by ladle analysis. Killed steel was used. The physical tests were waived, since it is known that specimen cut from thick slabs will not test as high as those from ordinary structural shapes. Lower designing unit stresses were used to compensate for the lower yield point. For material having a yield point of 45,000 p.s.i., a 70 foot diameter roller would have a permissible line bearing of 112,000 lbs. per lineal inch. The actual line bearing, based on a net width of 40.5", is 119,000 lbs. per lineal inch. Professor Wilson's tests indicated that the critical load was 50 per cent greater than the permissible load given by the above formula, and for the case here considered would be approximately 168,000 lbs. per lineal inch.

The width of the area in contact due to flattening according to Hertz's formula, which is $0.004\sqrt{P \times D}$, is about 4". On that basis the average unit pressure is about 30,000 p.s.i., and the maximum pressure 1.27 x 30,000 or 38,000 p.s.i.

The natural tendency would be to construct the shoe, using one main web transverse to the center line of the truss. To do so, would require excessively large welds attaching the longitudinal stiffening plates to the web. The shoes were constructed using three 3" longitudinal webs with short transverse sections of 5" material between the webs. This arrangement greatly reduced the shear on the vertical welds.

The shoes, upon completion of the welding, were normalized in accordance with the 1946 ASME code for the fusion welding of unfired pressure vessels.

Floor Beam Hangers

Considerable time was devoted to the design of the floor beam connections and to the design of those truss members commonly called floor beam hangers. The rotation of the ends of floor beams, particularly in structures having wide roadways, due to the deflection of the beams caused by the dead load of the floor system, together with live and impact loads, produce high bending stresses in the floor beam hangers.

Professor L. T. Wyly of Purdue University, in an article which appeared in Bulletin 454 of the AREA under the heading "Two Problems in Bridge Design," points out that unless a correction is made in the usual analysis of the frame formed by a floor beam, the floor beam hangers and the top strut or portal frame, stresses considerably in excess of those calculated by the usual analysis should be anticipated.

Hangers in the plane under discussion

are displaced laterally at the top of the floor beam, as well as rotated through the same angle as the end rotation of the floor beam, since floor beams are usually relatively deep compared to the width of the floor beam hangers. The stress resulting from this translation produces a stress that might readily be overlooked in the design of the hanger.

The end connections of all floor beams were canted out at the top so that under full dead load there would be no lateral bending stress in the hangers due to end rotation of the floor beams. This induced an erection stress of opposite sign in the hanger due to bending, about equal to one half that resulting from full dead, live and impact load.

The design of the details of the floor beam connections was an interesting problem of stress distribution, due to the interruption of the hangers by the continuity of the bottom chords and the introduction of a diaphragm in the chord in line with the hanger and the floor beam.

Lateral Bending in Floor Beams

The Bethlehem Steel Company, fabricators and erectors of the three main spans, fabricated the stringers to the theoretical panel length and cambered the trusses so that under full dead load the trusses would assume the design proportion, that is, have the grade and panel length shown on the stress sheet.

It was realized that during erection the ends of the floor beams would in many cases have to be bent laterally, in order to connect them to the trusses on account of the increment of length added or subtracted from the bottom chord members in cambering. This bending was relieved to considerable extent by resting the stringers on shelves provided on occasional floor beams, rather than framing them into the floor beam. A pour sequence, for the concrete floor slab, was selected, which would not aggravate the lateral bending in the floor beams. It was also realized that after all construction was finished, that lateral bending in the floor beams would be produced by the passage of live load over the structure. The lateral flexibility of the top flanges of the floor beams was increased by painting their top surfaces with an asphalt paint, so that there would be no bond between concrete and steel, from the truss connection to the first interior stringer. The concrete slab was carefully formed to permit lateral bending for the length thus painted.

Truss Details—Panel Point U14

Figure 3 shows the details of the most critical joint in the trusses which occurs at the top chord panel point directly above the main piers.

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(*Continued from Page 6*)

ging of an outlet stream by ice may so diminish the outflow that the lake above will rise and the downstream lake will fall. Such clogging may result from an exceptional amount of ice cover, lasting for many weeks, or from an ice jam of much less duration but of much greater clogging effect.

In some winters the discharge of the St. Clair and Detroit Rivers has been reduced as much as one-half, for as long as a month, by ice obstructions. In other open winters there has been very little obstruction. The discharge of the Niagara River is seldom reduced by ice more than about 5 per cent for a month, although for brief periods this reduction has been as much as 10 per cent.

As an average, the outflow from Lake Huron is reduced because of ice, by 42,500 cfs (cubic feet per second) for the month of February, by 28,000 cfs for the months of January and March, about 14,000 cfs for April and 6,000 for December. The yearly average figure used for correction of discharge from Lake Huron, due to ice, is 10,000 cfs. The correction for Lake Superior is 700 cfs, for Lake Erie 1500 cfs, and for Lake Ontario 4,400 cfs.

Winds

The temporary effect of winds on lake levels is of comparable importance locally. A sudden shift in the direction of the wind can change the level of any of the Great Lakes, at a given point, as much as one foot in an hour. Such a change as this, only one foot, is of no particular importance, but the effect of a strong wind blowing for a long time from one direction can be sufficient to cause considerable damage.

Lake Erie is particularly susceptible to wind effects, because of its relatively shallow depths and because its greatest length lies in the general direction of the strongest winds.

The most extreme levels reached at the two ends of Lake Erie occurred in a storm January 10, 1889. The maximum wind, measured at Buffalo, was 55 miles per hour. The water level at Toledo dropped 7.1 feet and at Buffalo it rose 8.2 feet, total difference in water level between the two ends of Lake Erie 15.3 feet.

During a severe gale October 14, 1893, the lake level at Amherstberg, Ontario, fell 5 feet and at Buffalo it rose 5.3 feet, making a difference of 10.3 feet between the two ends of the lake. In this storm the level at Buffalo fluctuated 8.1 feet, from —2.8 to +5.3 on the gauge.

Records of a 3-foot rise at one end of Lake Erie and a 3-foot drop at the other, total difference in level 6 feet, have been frequent. Such changes occurred about six times a year, from 1886 to 1895.

Wind storms on Lake Michigan have not caused such violent changes in lake level as on Lake Erie, but their effect has been considerable. Three cases will be cited.

On October 21, 1929 a north wind steadily increasing from 15 miles per hour to 38 miles per hour raised the lake level at Chicago 0.70 foot in 24 hours. This wind, continuing from the north and increasing in velocity from 38 mph to 58 mph over the next 15 hours, raised the local lake level an additional 1.25 feet. The total rise was 1.95 feet (from +1.60 CCD to +3.55) in 37 hours. As this wind, still from the north, subsided from 58 mph to 20 mph over a period of 18 hours, on October 23, the lake level at Chicago dropped 1.05 feet, from its maximum height.

On December 17, 1929, a north wind shifting to the northeast and increasing from 15 mph to 50 mph, over a time period of 34 hours, raised the lake level at Chicago 1.80 feet (from +1.20 to +3.00 CCD). As this wind subsided and changed direction from northeast to northwest and finally to west, over a time period of 45 hours, the lake level dropped 2.00 feet by December 20.

On November 6, 1951, an east wind at 17 miles per hour, shifting to northeast and then north and increasing to 42 mph, over a time period of 31 hours, raised the lake level at Chicago 1.70 feet (from +1.70 to +3.40 CCD) by 8 a.m. November 7th. As this wind, still in the north, subsided over the next 24 hours, to 9 mph, the lake level dropped 1.10 feet. In the following 12 hours the wind shifted from the north to the south and increased to 23 mph; and the lake level dropped an additional 0.8 foot. The total drop in 36 hours was 1.9 feet (from 3.40 to +1.50 CCD). These changes were caused by continual steady, but not extremely strong winds.

Tides

True tides, both lunar and solar, occur on the Great Lakes and were observed and studied many years ago by Col. J. D. Graham and Gen. C. B. Comstock. Investigations of the U. S. Coast and Geodetic survey indicate that the spring (combined lunar and solar) tide is less than 2 inches. Other records indicate a lunar tide of 1¾ inches and a spring tide of 3½ inches at Chicago, and a lunar tide of 1 inch at Milwaukee and a spring tide of 1¾ inches at the west end of Lake Superior. Such small fluctuations as 1 to even 3 inches, because of tides, are of small consequence in lakes subject to ten or more times as much fluctuation, by winds.

Seiches

Seiches are sudden brief changes in a local lake level, caused by quick changes in atmospheric or barometric pressure. Such changes are due to the passing of a barometric wave or a wave of low atmospheric pressure over the region where the seiche occurs. An inch of mercury is equivalent to a foot of water in resistance to pressure; and the passing of a storm center with a barometer reading an inch below normal had the

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same effect as reducing the water pressure a foot. When such a phenomenon occurs at one end of a lake, the water surface there will rise, due to the lessened atmospheric pressure at the time of passing. The opposite end of the lake is necessarily subject to higher relative atmospheric pressure and the water surface there will fall. An oscillation is thus set up, which continues with gradually diminishing amplitude until the seiche is ended and the water is returned to its normal level.

Seiches, with as much as 4.5 feet variation in water surface level, are not unusual in Lake Michigan, though infrequent. In this unpredictable movement the surface of calm water will rise as much as 2 feet or more, then within 20 to 30 minutes swing back down till it is 2 feet or more below the original level. Thereafter the water level will oscillate in 20 to 30 minute cycles, over a gradually diminishing amplitude, until the water has returned to its original level, usually in about four hours.

A great seiche was observed along the west shore of Lake Huron, between Alpena and Cheboygan, Mich., May 22, 1925. About an hour before this occurred a thunderstorm, attended and followed by sharp changes in barometric pressure, moved rapidly from west to east, the line of its passage being north of Rockport. At Rockport the lake surface rose 5 feet in six minutes and then dropped as rapidly as it rose to a point 3 feet below its original level; total range 8 feet. This change in lake levels was followed by oscillations of gradually diminishing amplitude and apparently irregular time period. At Calcite, Mich., the water rose 4 feet above and then fell 5 feet 4 inches below the original level, making a total range of 9 feet 4 inches.

Seiches have not occurred with the passage of every storm; and they have occurred many times in fair weather when there was no other indication of any atmospheric disturbances. Seiches have probably occurred in many storms, when the wind effects have been sufficient to mask any change due to change in barometric pressure.

Earth Tilt

Considerable evidence exists that the earth's crust in the Great Lakes region is gradually tilting, rising to the north of an axis, or hinge line, which extends west, about 20 degrees north approximately through Fort Huron, Mich. It is subsiding at some points south of this line. This phenomenon has been studied by geologists and others for more than 60 years.

As far back as 1890 Dr. Grove Carl Gilbert recommended to the U. S. Lake Survey and to the U. S. Coast and Geodetic Survey that an investigation be made to determine if tilting was taking place and, if so, at what rate. No action was taken but Dr. Gilbert studied the matter further for the U. S. Geological Survey. It was also studied by Frank B. Taylor and the results stated in a monograph, published 1915 by the U. S. Geological Survey. It has been studied by Professor Hobbs, of the University of Michigan and by Sherman Moore, of the U. S. Lake Survey.

John R. Freeman, in his report 1925-1926, on the Regulation of the Great Lakes, studied all the data available on this subject and came to the definite conclusion that earth tilt is still taking place; that harbor depths in the Lake Superior region are decreasing from this cause at the rate of about 1 foot per 100 years; and that harbor depths at Chicago and Cleveland are increasing substantially but at a lesser rate. Freeman concluded that, since this movement had been going on slowly for more than 20,000 years it was likely to continue for another 1,000 years, by which time the problem of keeping the water of the Great Lakes from flowing across the divide at Chicago, into the Mississippi basin, might become serious.

Water Yield of the Great Lakes

Artificial changes in the levels of the Great Lakes include changes in the lake outlets which, in most cases, permit the discharge of more water than would have been the case if each of these outlets had been left in its natural state. To analyze the effect of outlet changes, it is necessary to know the quantities of water supplied to each of the lakes and discharged through these outlets.

The calculation of the amount of water supplied to any one of the Great Lakes, other than the inflow from the lake next above, and designated as the "water yield" or local supply of that lake, is a long and tedious process. Computing it by the run-off method involves the rainfall on the drainage area, which is slightly different on the water surfaces and on the land areas, as well as having considerable seasonal variations. It also involves evaporation from the water surface, with wide seasonal variations and evaporation from the land and transpiration from vegetation.

Annual average precipitation is approximately 28 inches in the Lake Superior region, about 31 to 32 inches for Lake Michigan and Huron, about 33 to 34 inches for Lake Erie, and about 34 inches for Lake Ontario.

Annual average precipitation and reasonable estimates of evaporation and transpiration, in inches per year, and the water yield of the various lakes based upon the same, for the 65 years 1860 to 1924, are indicated in the tabulation below.

	Lake Superior	Lakes Michigan-Huron	Lakes St. Clair-Erie	Lake Ontario
Precipitation—	28	31-32	33-34	34
Evaporation from water surfaces—	22	28	36	33
Evaporation from land and transpiration from vegetation—	14	22	24	23
Annual run-off in inches, from entire drainage area—	10.7	8.4	7.3	7.9
Area of watersheds, in square miles—	80,700	141,600	41,100	34,600
Run-off, cfs per square mile—	0.943	0.745	0.644	1.088
Water yield, cfs—	76,000	105,400	26,500	37,700
Flow of Niagara River—			207,900 cfs	

These were the figures adopted by the Engineering Board of Review of The Sanitary District of Chicago, in 1925, and used by John R. Freeman, in his report on the Regulation of the Great Lakes, 1926.

Another method of computing the water yield of the Great Lakes was that used by the International Waterways Commission in its studies of the Regulation of Lake Erie, report made 1910 (House Document 779, 61st Congress 2nd session). In this method the water yield, by months, is determined by deducting the inflow to the lake from the discharge of the lake and adding the storage accumulated in the lake in that month, if the level rises; or subtracting the amount of storage lost, if the level drops. In brief the formula is:

Water Yield = Discharge — Inflow ± Storage.

This Commission computed the supply factors for all the Great Lakes, by months, for the period 1860 to 1907. Lake St. Clair was included in the Michigan-Huron area. The average water yields of the lakes and discharges of the outlet streams, for the 48 years, 1860-1907, were as follows:

Lake Superior (St. Mary's River)	82,000 cfs
Lakes Michigan-Huron-	
St. Clair	122,200 "
Detroit River:	204,200 "
Lake Erie	8,000 "
Niagara River:	212,200 "
Lake Ontario	42,200 "
St. Lawrence River:	254,400 cfs

The average monthly water yield of Lake Superior ranged between 175,700 cfs and negative 10,700 cfs, the minus value being in December and indicating that evaporation from that lake may be greater than precipitation on the lake surface and run-off from its tributary watershed.

The mean monthly local supply to Lakes Michigan-Huron ranged between 257,800 cfs in May and 8,200 cfs in October.

The mean monthly local supply to Lake Erie ranged between 56,100 cfs in April and negative 31,800 cfs in October. In the six months, July to December, the evaporation from the surface of Lake Erie has exceeded the precipitation on the lake surface and the run-off from the tributary watershed.

These conclusions of the International Waterways Commission in 1910, as to the water yield of the Great Lakes, 1860 to 1907, were not much different from conclusions of Freeman, Horton, Grunsky and others, on the Engineering Board of Review of The Sanitary District of Chicago in 1925. One hydraulic engineer, E. E. Haskell, was a member of both commissions. Some of these later conclusions are cited.

In the average year of the 25 year period, 1900 to 1924, the water yield from the local drainage of Lake Superior was negative in the winter months, December, January, February, due to evaporation and to ice clogging the tributary streams. In the same period the average water yield of the Lakes Michigan-Huron drainage area was negative, to small extent, in the month of November. This was due to evaporation and lessened stream inflow.

In the same 25 year period, the water yield from the local drainage of Lake Erie was negative, as an average, in the autumn months of September, October, November—due to excessive evaporation.

For the entire year the rainfall on the water surfaces of the Great Lakes exceeds the evaporation by about 4 inches. The rain is heaviest in the spring months and the evaporation greater in late summer and fall. This is one reason for the spring rise and autumn lowering of lake levels.

Annual evaporation of 27 inches from the 95,100 square miles of lake surface is equivalent to an annual average of 188,000 cfs, which is equal to about 80 per cent of the flow of the St. Lawrence River. In the three months, August to October, it is probable that more water evaporates from Lakes Superior, Michigan, Huron and Erie than flows through Niagara River.

The United States Lake Survey, in its Bulletin No. 59, April 1950, Survey of Northern and Northwestern Lakes, gives figures for the water yield of the various lakes and discharge of their outlet rivers for the 50 year period 1900 to 1949, as follows:

Lake Superior (St. Mary's River)	82,000 cfs
Lakes Michigan-Huron	103,100 "
St. Clair River:	174,600 "
Lakes St. Clair-Erie	19,300 "
Niagara River:	193,900 "
Lake Ontario	36,100 "
St. Lawrence River:	230,000 cfs

The International Joint Commission, in its report on the pollution of boundary waters, 1951, figured the average flow of the Niagara River for the 90 year period 1860 to 1949 at 202,000 cfs.

Comparative figures for discharge of the Niagara River are as follows:

48 years, 1860-1907, — International Waterways Commission	212,200 cfs
65 years, 1860-1924,—Freeman, Horton, Grunsky	207,900 "
90 years, 1860-1949, — International Joint Commission	202,000 "
50 years, 1900-1949,—Lake Survey	193,900 "

At first glance these figures may not appear consistent, but the differences are easily explained. The first period, 1860-1907, included the extremely wet years around 1861, 1876, 1886 and the fairly wet years near 1907. The second period, 1860-1924, included all the wet years of

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the first period, plus the dry years 1917 to 1924. The third period, 1860-1949, included all of the preceding, plus a few wet years around 1929 and many dry years in the nineteen thirties and early nineteen forties. The last period, 1900-1949, excluded all the extremely wet years around 1861, 1876, 1886, and included only two fairly wet periods around 1907 and 1929.

At any rate the local water supplied to the various lakes and the water discharged therefrom may be taken, in round numbers as follows:

	cfs	cfs
Lake Superior (St. Marys River)	72,000 to	75,000
Lakes Michigan-Huron	103,000 to	105,000
St. Clair River:	175,000 to	180,000
Lake Erie	20,000 to	25,000
Niagara River:	195,000 to	205,000
Lake Ontario	36,000 to	38,000
St. Lawrence River:	231,000 to	243,000

The records do show that in the 90 years of which records are available the average levels of the last 50 years are less than the averages of the earlier 65 year period, and the fall between the various lakes has changed as follows:

	1860-1924	Average Decrease	1900-1949
Elevation Lake Superior—	602.3 ft.	0.1 ft.	602.2 ft.
fall to Lake Huron—	21.2 ft.		22.4 ft.
Lake Michigan-Huron—	581.1 ft.	1.3 ft.	579.8 ft.
fall to Lake Erie—	8.6 ft.		7.8 ft.
Lake Erie—	572.5 ft.	0.5 ft.	572.0 ft.
fall to Lake Ontario—	326.3 ft.		326.2 ft.
Lake Ontario—	246.2 ft.	0.4 ft.	245.8 ft.

Changed Outlet Conditions

The most important artificial effect on lake levels is that due to changed outlets. Enlarging an outlet will increase the discharge and lower the level of the lake above. Obstructing an outlet will lessen the discharge and cause a rise in the level of the lake above.

The outlet of Lake Superior is the St. Marys River, in which, rapids about one-half mile in length and dropping about 19.5 feet connect the upper and lower river. The submerged natural rock weir at the head of the rapids controlled the discharge from Lake Superior.

Changes in this outlet include a power canal and navigation lock on the Canadian side, in the rapids, and four navigation locks and a power canal constructed on the Michigan shore. These power canals have a combined discharge capacity of more than 50,000 cfs and the locks use about 1,000 cfs. Another power plant has been built in the rapids, on the Michigan side, and part of the original channel at the head of St. Marys Rapids has been permanently blocked. The net result of these changes is an increase of perhaps 25 per cent in the discharge capacity of the outlet, all of it being subject to manual control.

The extensive diversions of water for power purposes at St. Marys Falls, most of it through additional outlet channels (later amounting to approximately 50,000 cfs by 1925) made it necessary to construct control gates (sluice gates) across the river at the head of the rapids to control the level of Lake Superior. These 16 gates have been in full service since 1917 and it has been possible to control the discharge from Lake Superior within very narrow limits.

The International Joint Commission, May, 1914, fixed the desirable limits for the level of Lake Superior at 602.1 feet above mean sea level, as minimum, and 603.6 as maximum, a range of 1.5 feet. Due to the continuing deficient water yield in the dry period 1917 to 1925 it was impossible to hold the level above the desired minimum stage in the years 1918 to 1927, but since that time these regulating works have been reasonably effective. Fluctuations of the Lake Superior water level have been held within the prescribed range of 1.5 feet, monthly average, except for a few instances in the winter and early spring months.

The Joint Board of Engineers on St. Lawrence Waterway Project report November 16, 1926, concluded that the operation of the Lake Superior regulating works had affected somewhat the levels of the other lakes; that the retention of water in Lake Superior had lowered the levels of Lakes Michigan-Huron about 4½ inches and Lakes Erie and Ontario 3 inches, by 1922-1923; but that the release of surplus stored water from Lake Superior 1923 to 1925 had raised the lower lakes so that by January 1926 their levels were slightly higher than they would have been with no regulation of Superior.

In the regulation of Lake Superior, the effort is made to have the level near but not below the minimum stage of 602.1 about February-March, and near but not above the maximum stage of 603.6 by about August-September. In November, 1951, the level was 603.4 and in December it was 603.1, indicating the improbability of the desirable low level being approached in 1952, without abnormal discharge from Lake Superior.

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The outlet of Lake Huron is the St. Clair River, which has a sand and gravel bed. This river, at the entrance from Lake Huron, is contracted in a deep and narrow channel, known as the Port Huron Rapids, for a distance of about 8,000 feet. The water current is 4 to 5 miles per hour. This is the principal control point for the discharge from Lake Huron, although other secondary control reaches were the shallow natural depth in Lake Huron at its approach to the outlet, the delta of the St. Clair River in Lake St. Clair, the shallow bay at Grosse Point where Lake St. Clair empties into the Detroit River, and the shoals in the lower Detroit River.

Considerable changes in the cross-sections of the streams have been made at all of these critical or control points, most of which have increased the discharge capacity.

The natural depth in Lake Huron at the approach to the St. Clair River was 16 to 18 feet. A channel 2,400 feet wide and 21 feet deep was dredged across this shallow reach, 1893 to 1896. This dredging extended into the St. Clair River, where a channel was cut 300 feet wide, to the same depth. A later improvement, by 1950, provided a channel 800 feet wide and 26 feet deep through the 4.8 miles of this shoal area.

Records indicate that between 1890 and 1900, the discharge capacity of the St. Clair River increased to an extent sufficient to lower the level of Lake Huron 0.34 foot. This has been ascribed to natural erosion of the gravel bed of the river, through the Port Huron Rapids. Such erosion was probably promoted by the dredging in Lake Huron, above, and in the St. Clair Flats, below. Shoaling caused by the wrecks of two schooners in the rapids in 1900 reduced this lowering to 0.24 foot.

After 1908 certain licenses of the Province of Ontario, Can., dredged gravel from the channel at the foot of the Port Huron Rapids, to improve a navigable depth to the Point Edward docks. The amount removed was presumed to be about 1,500,000 cubic yards, but a survey made in 1925 disclosed that dredging had been carried on by these licensees and others to such an extent as to materially enlarge the cross-section of the river through a distance of about 6000 feet. Through about one-half of this distance, the enlargement was more than 30 per cent of the original area. About 2,400,000 cu. yds. of material had been removed. The increase in discharge of the St. Clair River, because of such enlargements, was sufficient to permanently lower the level of Lake Huron an additional 0.29 feet.

Due to these two changes in the cross section of the St. Clair River, in the critical control reach, the joint Board of Engineers on the St. Lawrence Waterway Project, 1926, concluded that the levels of Lake Michigan-Huron had been permanently lowered about 0.6 foot.

By 1950 the American side of this river, used by downbound traffic, had been improved to a depth of 25 feet, for a width of 1,000 feet. The Canadian side, used by upbound traffic, had depths of 21 feet or more.

The outlet from Lake Huron was also increased by the Black River Canal, but its effect on the lake level has been small. This canal, about 35 feet wide and 6 feet deep, extends from the west shore of Lake Huron at a point about 1½ miles north of the foot of the lake, westward a little more than a mile to connect with Black River. This river flows south through Port Huron, receives the sewage of a large part of this town, and discharges it into the St. Clair River at a point about 2½ miles below the foot of Lake Huron. The average amount of water diverted from Lake Huron, through this additional outlet, has been 400 cfs, sufficient to lower the lake level about one-fourth inch, a lowering which has been generally disregarded.

Originally the St. Clair River emptied into Lake St. Clair through seven principal channels across the delta, known as the St. Clair Flats. Water depths at the outlet ends of these channels ranged from 2 to 6 feet. The St. Clair Flats canal was dredged across this delta 1867-1871, to 300 feet width and 13 feet depth; and improved from time to time until, by 1906, there were two channels, each 300 feet wide and 20 feet deep.

Lake St. Clair empties into the Detroit River through an outlet bay at the southwest corner of the lake at Grosse Point. Under natural conditions the water in this outlet bay was 14 to 16 feet deep over a length of three miles. The Grosse Point canal was cut through this shoal area, 800 feet wide and 20 feet deep, 1893 to 1897 and deepened to 21 feet by 1921.

By 1950, the St. Clair Flats canal had been widened to a channel 700 to 1000 feet wide and at least 25 feet deep. This channel continued 700 to 800 feet wide

(*Continued on Page* 30)

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169-83 Donald T. Vincent, Research Engineer, Victor Adding Machine Co., 3900 N. Rockwell St.

170-83 E. C. Edwards, Adminstrative Assist. to Mgr., Freyn Engineering Dept., Koppers Co., Inc., 109 N. Wabash Ave.

171-83 Robert P. Martin; Supervisor, Testing Engineers; United States Steel Co., 3426 E. 89th St., Sta. #31.

172-83 John F. Foulkes, Junior Engineer, Commonwealth Edison Co., 72 W. Adams St.

173-83 Donald W. Gant, Assistant Engineer, Commonwealth Edison Co., 2233 S. Throop St.

174-83 Robert E. Jonelis, Junior Engineer, Commonwealth Edison Co., 72 W. Adams St.

175-83 Clayton Mark, III, Engineer, Clayton Mark & Co., 1900 Dempster St., Evanston, Ill.

176-83 Robert F. Sheridan, Service Engineer, The Master Builders Co., 228 N. LaSalle St.

177-83 Marshall H. Uhl, 1817 N. Karlov Av., — attending Illinois Institute of Technology.

178-83 John G. Eilering, Senior Engineer, Commonwealth Edison Co., 72 W. Adams St.

179-83 Bennie B. Stephenson, Assistant Engineer, Commonwealth Edison Co., 2233 S. Throop St.

180-83 Alan Morbeck, Secretary, Dahl-Stedman Co., 7 S. Dearborn St.

181-83 O. W. Tuthill, Chief Engineer, Illinois Bell Telephone Co., 212 W. Washington St.

182-83 Douglas W. Rogas, Power Supervisor, Public Service Company of Northern Illinois, 423 Childs St., Wheaton, Ill.

183-83 William Misic, Junior Engineer, Exp. Lab.; Vapor Heating Corp., 4501 W. 16th St.

184-83 Hubert A. Toci, Junior Engineer, Commonwealth Edison Co., 72 W. Adams St.

185-83 Michael A. Miller, Assist. to Regional Manager, Worthington Pump & Mach. Corp., 400 W. Madison St.

186-83 Russell M. Butler, Engineer, Armco International Corp., 109 N. Wabash Av.

187-83 Robert J. Koenig, Junior Engineer, Bloomer Heating & Ventilating Co., 1237 W. 47th St.

188-83 James H. Potter, Professor of Mech. Engrg., University of Illinois, Urbana, Ill.

189-83 Cornelius Elsasser, Jr., Sales Engineer, Kelso-Burnett Electric Co., 223 W. Jackson Blvd.

190-83 V. K. Genger, Vice President; McClure, Hadden & Ortman, Inc., 168 N. Michigan Av.

191-83 Kenneth V. Westerberg, Engineer; Alvord, Burdick & Howson, 20 N. Wacker Dr.

192-83 Charles W. Starbuck, Voltz Rd., Northbrook, Ill., attending Illinois Inst. of Tech.

193-83 Andrew C. Adamson, Modelmaker, Webster Chicago, 5610 Bloomingdale Av.

194-83 Clarence B. Williams, Engineer, Standard Oil Co., 910 S. Michigan Av.

195-83 Lenox R. Lohr, President, Museum of Science & Industry, 57th St. & South Lake Shore Dr.

196-83 Curtis LeFever, Hydrographic & Geodetic Engr., U. S. Coast & Geodetic Survey, 185 N. Wabash Av.

197-83 Walter E. Dwy, Assistant Engineer, The Baltimore & Ohio Chicago Terminal R. R. Co., Grand Central Station.

198-83 William H. Schultz, 6440 N. Nordica Av., attending Illinois Institute of Technology.

199-83 Ellis G. Bohon, Proprietor, E. G. Bohon & Co., 134 S. LaSalle St.

200-83 Fred Rebitzer, General Manager, Cury Manufacturing Co., Inc., 447 N. Wood St.

201-83 Dwight E. Perrine, Office Engineer, Chicago & Western Indiana Railroad Co., 47 W. Polk St.

202-83 Peter L. Simonetti, Chief Engineer, Bloomer Heating & Ventilating Co., 1237 W. 47th St.

203-83 Valentine B. McGowan, Engineer Grade I, Commonwealth Edison Co., 72 W. Adams St.

204-83 John S. Knight (Rein.), Regional Engineer, The Baltimore & Ohio Chicago Terminal Railroad Co., 201 W. Harrison St.

205-83 Edward D. McCauley, Junior Engineer, Bloomer Heating & Ventilating Co., 1237 W. 47th St.

206-83 Lewis C. Barbe, 5322 Hutchinson St., attending Illinois Institute of Technology.

207-83 Fred R. Hautz, Telephone Equipment Engr., Western Electric Co., Inc., Hawthorne Station.

208-83 Edwin F. Langhenry, Sales Engineer, Westinghouse Electric Corp., X-Ray Div., 2211 W. Pershing Rd.

209-83 Robert G. Burkhardt, Mechanical Supt., Raymond F. Houlihan & Associates, 30 N. Dearborn St.

210-83 Stanley V. Sramek, Fire Insurance Inspector, Cook County Inspection Bureau, 175 W. Jackson Blvd.

211-83 Raymond H. Naras, attending Rose Polytechnic Institute, Terre Haute, Ind.

212-83 Roy A. Anderson, Electrical Squad Leader, Freyn Engineering (Koppers), 109 N. Wabash Av.

213-83 Donald H. McIntosh, Application Engineer, Allis-Chalmers Mfg. Co., 135 S. LaSalle St.

214-83 J. Henry Schmidt, Supervisor-Finishing Dept., Acme Steel Co., 2840 Archer Av.

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across Lake St. Clair, which was originally only 21 feet deep and on through the Grosse Point canal to the Detroit River.

The improvement of the lower reaches of the Detroit River, for navigation, has been almost continuous since 1876. The shallowest place was at the Limekiln Crossing, just upstream from the village of Amherstburg, Ontario, where the natural water depth was 13 to 15 feet. Another shallow place was at Ballard's Reef, a little further upstream.

Beginning in 1876, a channel 300 feet wide and 20 feet deep was cut across the Limekiln Crossing. This Amherstburg channel was extended and enlarged from time to time until it was 800 feet wide and 22 feet deep, from Ballard's Reef to Lake Erie, by 1920. This channel is used for upbound navigation.

The Livingston channel, for downbound navigation, to the west of the Amherstburg channel, was dug 22 feet deep and 300 to 800 feet wide, 1908 to 1912. The width of the major portion was increased from 300 feet to 450 feet, 1921 to 1925. The depth was increased to 26 feet by 1950.

A channel 800 feet wide and 21 feet deep was cut through the shoal at the mouth of the Detroit River 1896 to 1897. This was widened to 1200 feet and deepened to 26 feet by 1950.

It has been claimed that the material excavated from three channels, particularly in the Detroit River, was so placed as to form obstructions to flow in the river which would be equivalent to the increased discharge capacity resulting from the improved navigation channels. This is probably true for the work subsequent to about 1900.

It is a fact that the levels of Lakes Michigan-Huron dropped, 1886 to 1895-96, about 3.5 feet, as computed from annual average levels; and that the levels since that time, even in the high years of 1929 and 1951 have not risen within one foot of the high levels of 1860-61, 1876 and 1886. In other words, since the improvements for navigation in the Detroit and St. Clair Rivers, the levels of Lakes Michigan-Huron have been fluctuating in a plane about one foot lower than before substantial progress had been made on these improvements. Of this, some 0.60 foot was due to erosion and dredging in the St. Clair River.

Niagara River is the natural outlet of Lake Erie. The principal control of flow from the lake was a group of rock reefs: Limekiln, Bird Island and Horseshoe Reefs, at the head of the river, where it was about one mile wide. Water depths were 9 feet over Bird Island Reef. About a mile downstream, opposite Fort Erie, the river is contracted to about 2000 feet width, with an original maximum depth of 20 feet. This section used about 40 per cent of the average slope of the river from Lake Erie to Niagara Falls and served as a natural throttle and control for the outflow from Lake Erie.

The principal change in this outlet was the construction of the Black Rock Canal along the New York shore, water depth 21 feet, width 200 feet to 350 feet. Excess flow of 1,000 cfs through this added outlet has had the effect of lowering Lake Erie 0.05 foot, or about $\frac{5}{8}$ inch. This has lowered Lakes Michigan-Huron about one-fourth as much or approximately $\frac{1}{8}$ inch.

The Welland Canal provides an additional outlet for Lake Erie. Flow of approximately 3,100 cfs through this canal, about 1925-1926, had the effect of lowering the level of Lake Erie 0.15 foot, or about $1\frac{7}{8}$ inches. The new Welland Canal, now in service, with larger locks probably requires 5,000 cfs or more for lockage and its lowering effect on Lake Erie is about 0.25 foot, or 3 inches.

The taking of water from Niagara River, above the Falls, for power purposes through canals and conduits which are additional outlets, has a slight lowering effect on Niagara River. This occurs however at points so far downstream from Lake Erie that the effect on the level of Lake Erie is not appreciable.

The outlet of Lake Ontario is the St. Lawrence River, which flows through the wide Thousand Islands section and on through a deep unobstructed reach, a total distance of about 66 miles to the head of the Galops Rapids, which is the natural control section for the outflow from Lake Ontario. At this point the St. Lawrence River is divided into two channels, by Galops Island in midstream and Adams Island, a small island near the northwest corner of Galops Island. The channel on the American side is relatively shallow, the rapids steep, with heavy swells, making navigation impossible. The Canadian channel is deep and is used by down bound vessels. Up bound vessels of course use the Galops ship canal, locking up about 16 feet around the rapids. Discharge through the narrow passage between Galops Island and Adams Island, known as the Gut, introduced a strong cross current into the navigation channel. In 1903, the Canadians constructed a dam, of earth-and-rock-filled cribs, across the Gut, to eliminate this cross-current.

Blocking of this narrow outlet channel caused the level of Lake Ontario to rise 0.56 foot, or almost 7 inches at mean stage. The rise was about 8 inches under the high water conditions of 1951.

(Mr. Ramey's article will be concluded in the March issue.)

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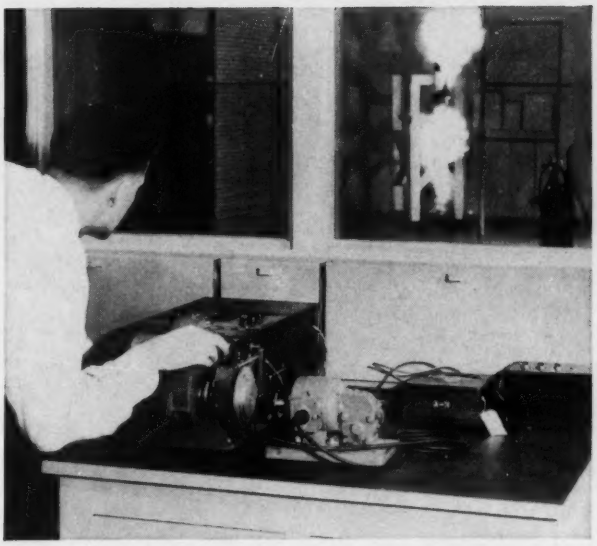

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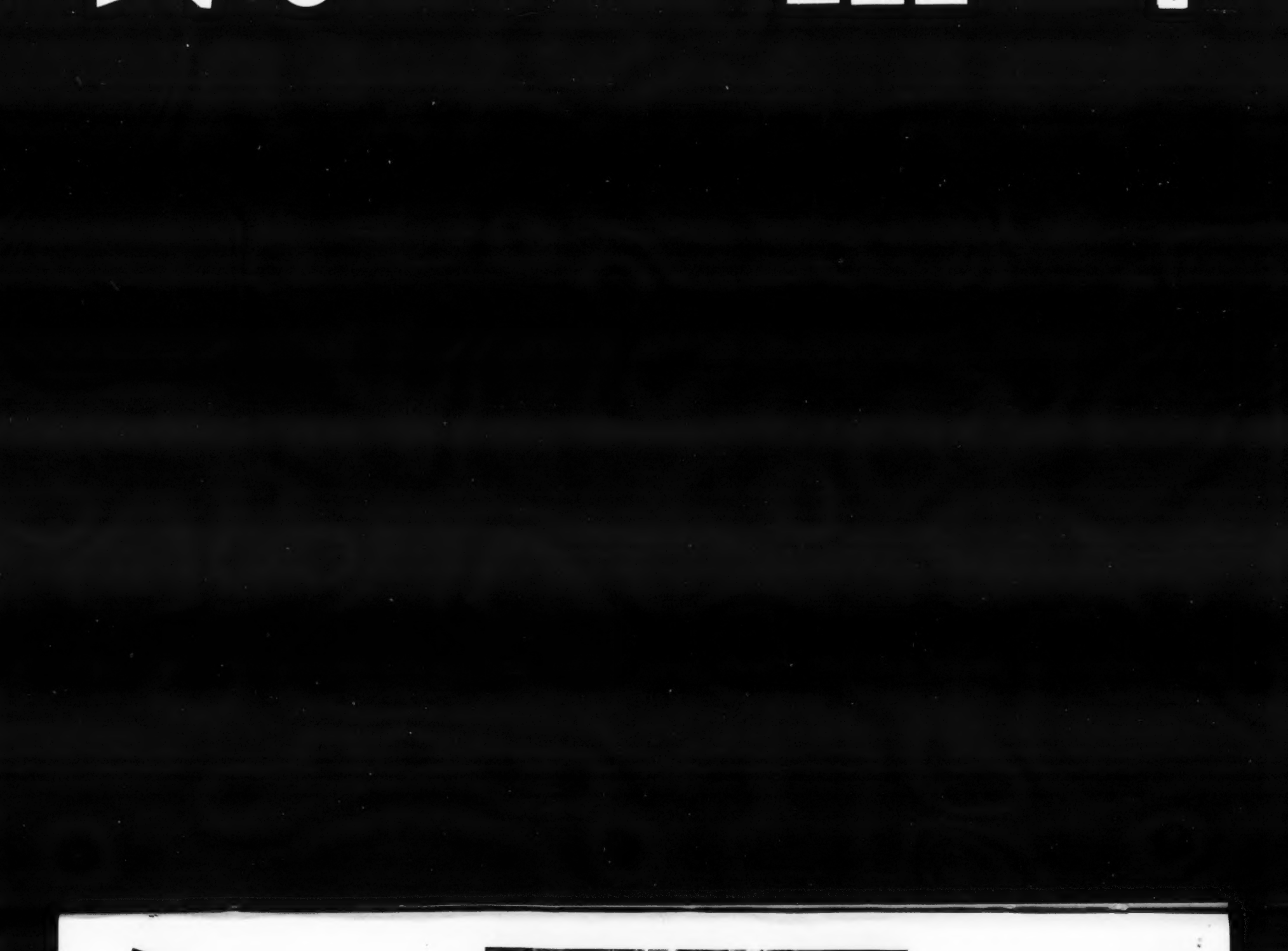
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